MIDDLE AND LATER STONE AGE LAND-USE AND LITHIC TECHNOLOGY IN THE EYASI BASIN, TANZANIA

By

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May you have interesting data . . .

Ancient Chinese Curse

This dissertation is dedicated to the memory of my sister, Mrs. Abbia Martha Mapunda, whose commitment to my education has led me achieve my academic dreams. I pray that The Lord rest her soul in Heaven, Amen!

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By

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Major Department: Anthropology

In this dissertation, I examine Middle Stone Age (MSA)/ Middle Paleolithic (MP) and Later Stone Age (LSA)/Upper Paleolithic (UP) behaviors as reflected by the spatial distributions of artifacts across the Eyasi Basin landscape, lithic raw material procurement and use, and lithic reduction sequences. The surface archaeological survey has found MSA and LSA artifacts occurring together in twelve of the fourteen surveyed areas. Also, the test excavations show that where the archaeological deposits are deep, both MSA and LSA artifacts occur with the latter stratified above the former. These indicate that MSA and LSA hominids of the Eyasi Basin may have had similar land-use systems.

The analyses of lithic raw material types show a localized pattern of raw material procurement and use for

both MSA and LSA hominids. This indicates that LSA hominids of the Eyasi Basin were no more mobile than their ancestors. Also the results of lithic technological analysis show that important aspects of the organization of lithic technology do not appear to have significantly changed between the MSA and LSA hominids in the Eyasi Basin. The conclusion reached is that in terms of land-use systems and lithic raw material procurement and use, the human boundary that separates "pre-modern" MSA hominids from "modern" hominids is not there--at least in the Eyasi Basin

Other important discoveries of the research include: 1) the vast richness of the Eyasi Basin for innumerable potential long-term as well as short-term/low budget research projects; 2) that Hadzabe foragers (hunter-gatherers) in the Eyasi Basin have the potential for generating not only analogs for interpreting forager's archaeological patterns, but also for developing explicit arguments for the linkage of ethnoarchaeology to the theoretical or epistemological framework of archaeology; 3) that the Eyasi Basin is ecologically fragile and insecure; and 4) the survival of Hadzabe foragers as a cultural group is nowhere in sight if present conditions continue.

CHAPTER 1
INTRODUCTION AND RESEARCH OBJECTIVES

The existence and magnitude of change in hominid adaptive behaviors and cultural capacities between the Middle and Later Stone Age (MSA and LSA) is fiercely contested. As a contribution to this debate, this dissertation examines MSA and LSA forager adaptive behaviors and cultural capacities in the Eyasi Basin, northern Tanzania. In particular, the study focuses on how MSA and LSA foragers utilized the Eyasi landscape and how they organized their lithic technologies. MSA and LSA forager land-use and the organization of lithic technology will be inferred using the spatial distribution of artifacts, raw material procurement and use, lithic reduction sequences and typology, and assemblage densities.

Accordingly, the study will evaluate hypotheses concerning changes in land-use and the degree and nature of planning in the utilization of the Eyasi Basin, and the organization of lithic technology among MSA and LSA foragers. Forager land-use and the organization of lithic technology are considered in this dissertation to provide the most fundamental kinds of data necessary in identifying the threshold, or more likely thresholds, that separate pre-"modern" from "modern" human behavioral capacities during the MSA and LSA. Therefore, the major hypothesis to be tested in

this study is "change" or "continuity" in hominid behaviors and cultural capacities between the MSA and LSA as reflected by land-use and the organization of lithic technology.

Research Objectives

The main objective of this research was to document the nature and distribution of Middle to Late Pleistocene archaeological occurrences across the landscape in order to 1) provide preliminary data on the range of MSA and LSA archaeological occurrences; 2) investigate how MSA and LSA foragers organized and used the landscape; 3) recover hominid fossil material that would increase the size and quality of the existing African hominid fossil sample for the Middle and Late Pleistocene; and 4) determine by means of surface survey and limited test excavations the archaeological potential of the region for long-term, multi-disciplinary studies (including large scale-excavations) of hominid biocultural evolution during the Late Quaternary.

A secondary objective was to examine and investigate modern Hadzabe forager mobility patterns in the Eyasi Basin. An understanding of the pertinent influences on present-day Hadzabe forager mobility in the Eyasi Basin can allow the development of the necessary empirical frameworks for explaining patterns observable in the archaeological record. I reason that such pertinent influences on Hadzabe forager movements may have influenced MSA and LSA foragers as well.

Selection of Study Area

The reasons for selecting the Eyasi Basin for research were many and varied but can be summed up into four parts. First, the Eyasi Basin was selected because of the need for a broad understanding of regionally adaptive behaviors of MSA and LSA foragers. The Eyasi Basin covers an area of about 2,500 km^2, and is physically and culturally bounded (see Chapter 4).

Second, the Basin is diverse, with varied landforms and ecozones, a wide range of plant and animal food resources, and water for human survival (see Chapter 4). These resources, and the varied landforms and ecozones, are potential factors that influence the spatial behavior of modern foragers in the Eyasi Basin, and may have also interacted to influence MSA and LSA forager spatial behaviors.

Third, the Basin presents a favorable environment in which to study surface artifact assemblages since the sparse vegetation cover provides optimal surface visibility facilitating a systematic and comprehensive archaeological survey.

Lastly, in terms of research, a substantial amount of work has been done in the past, but it has been "site"-oriented and aimed at establishing a regional culture-history (e.g., Mehlman 1989). The research area had not been subjected to systematic survey. Given that a group called

the Hadzabe still practice a foraging life-style in the Eyasi Basin, the lack of examination of the spatial behaviors of prehistoric foragers seemed to be a serious oversight. The limitations of a culture-historical approach alone is noted in Chapters 2 and 3. Nonetheless, this previous work is important because it provides both a reasonably dated culture-historic sequence for temporal determinations of surface material and a substantial database for comparisons.

The Overall Research Approach

The questions of forager land-use and adaptations have important spatial connotations. It is the latter that enables us to perceive forager land-use and adaptations from a dynamic perspective. Consequently, the research program has been applied as a form of landscape archaeology that combines ecological, geomorphological, and archaeological field surface survey and limited subsurface test excavations; an ethnographic study of modern Hadzabe forager mobility patterns is included as well.

The study has a general regional focus. The main benefit of a regional approach is that it allows one to develop a systematic spatial approach in which the process of culture change and hominid adaptations can be examined at various scales. As will be shown later, this research was planned and carried out to maximize data recovery, the analysis of which it is believed will add significantly to an

understanding of MSA and LSA forager spatial behavior in East Africa.

Dissertation Organization

Chapter 2 defines the research problem and identifies the paradigm that underlies this study. An understanding of MSA and LSA forager adaptive behaviors and cultural capacities is approached in this study from an adaptation perspective that is informed by cultural ecology and a spatial research strategy. This approach is germane for understanding the relationships between space, time, landscape, and foragers.

An assessment of previous MSA and LSA archaeological research in East Africa is provided in Chapter 3. It will be argued in this chapter that previous works have been severely limited, both in scale and in information provided. This is not an uncommon problem in African archaeology, where the amount of research is often irregular. With the absence of research there has also been a corresponding problem concerning the "quality" of research undertaken. As would be expected, with most work having been done in the 1960s, much of the inspiration for theory, methodology, and interpretations of MSA and LSA archaeology in East Africa is embedded within the context of previous earlier works. For example, in East Africa there have been few research strategies on the MSA and LSA that attempt to evaluate the archaeological record of an area through a regional program

such as that described earlier. Without such research designs, a thorough understanding of MSA and LSA forager behavior in the region is unlikely. An important contribution of this dissertation is to rectify this condition.

Chapter 4 describes the Eyasi Basin landscape and it's elements. These include: geology, geomorphology, drainage, ecology, economic potentials, past environments, and culture-stratigraphic framework. This information is critical for our understanding of past and present forager land-use, resource utilization, and adaptive systems in the Basin.

An overriding concern in Chapter 5 is to understand the factors that structure the Hadzabe foraging system in the Eyasi Basin. In particular, the chapter will examine how these factors govern Hadzabe land-use and resource utilization. The chapter is important in detailing how the Hadzabe foraging system operates and how it can be reflected archaeologically. In effect, this will involve generating empirical data that will be used to build testable hypotheses about MSA and LSA foraging systems in the Eyasi Basin.

From the beginning of this study, the Eyasi Basin landscape is seen as the context in which prehistoric and modern forager activities took or take place. This view and thinking requires a research design that also gives high priority to low-density as well as high-density artifact scatters or "sites". Chapter 6, therefore, examines the methods that I deemed significant to the investigation of MSA

and LSA forager land-use and adaptive behaviors in the Eyasi Basin. I argue that the methods of landscape archaeology make an informed approach to investigate the spatio-temporal distribution of MSA and LSA foragers. Also, in this chapter, I use the Hadzabe land-use and resource utilization behavioral patterns, and data on the MSA and LSA of East Africa and the Old World to formulate testable hypotheses and develop test implications about MSA and LSA forager spatial behavior in the Eyasi Basin.

Discerning prehistoric foraging systems requires inferences that demonstrate links between forager mobility range and the distribution of activities. Inferences then can be made about forager land-use and other adaptive behaviors and cultural capacities through the analysis of items of material culture found during the survey and test excavations. Consequently, Chapters 7 and 8 describe all the material culture, hominid and faunal remains, and geomorphologic data recovered during the survey and test excavations. Although numerous rock shelters with paintings were recorded and the art studied in the field, rock art data does not form a major part of this dissertation due to space and time constraints.

In Chapter 9, I conduct a technological and raw material analysis of the recovered artifacts. Also, the chapter describes the analytical techniques I used in my attempts to understand forager organization of lithic technology and raw material procurement and use in the Eyasi Basin. An SPSS

statistical program is then used to generate simple statistics and graphs.

In Chapter 10, I interpret the research findings and test the formulated hypotheses. Using data from Chapter 9, I infer MSA and LSA forager land-use strategies, adaptive behaviors, and cultural capacities in the Eyasi Basin. Finally, I conclude this research and consider directions for future research.

Evidently, this research has revealed five crucial issues:

1) that MSA and LSA foragers in the Eyasi Basin may have had similar land-use, raw material procurement and uses; suggesting "continuity" as well as "changes" in other aspects of hominid adaptations in the Basin;

2) the continuous spatial use of the Eyasi Basin landscape and rock shelters by both prehistoric (MSA and LSA) and present foragers;

3) the vast richness of the Eyasi Basin for innumerable potential long-term as well as short-term/low budget research projects as evidenced by the findings of this research (long archaeological sequence, hominid remains of "archaic" *Homo sapiens* and modern human skeletal remains, unrecorded rock art, etc.) along with the continuing endurance of the Hadzabe forager life style into the immediate present;

4) Hadzabe forager adaptations in the Eyasi Basin has the potential for generating not only analogs for interpreting forager's archaeological patterns, but also for

developing explicit arguments for the linkage of ethnoarchaeology to the theoretical or epistemological framework of archaeology; and

5) that the Eyasi Basin is ecologically fragile and insecure and the danger posed to it and the survival of Hadzabe foragers by the inevitable encroachment of modernization. This last issue has great implications to the Tanzanian Government that is trying to protect the Hadzabe foragers given the impending potential of their disappearance.

CHAPTER 2
RESEARCH PROBLEM AND THEORETICAL CONSIDERATIONS

Introduction

In this chapter, my major concerns are to define the research problem and identify the theoretical framework underlying this study. I define the research problem by reviewing the available data and arguments concerning MSA and LSA fossil hominids, chronology, and behavior. The theoretical framework is identified by discussing the theories of cultural ecology, ecosystems, and evolutionary ecology.

Background

The time between > c. 200,000 and c. 50,000 years BP (Before Present) was a critical time span in hominid biocultural evolution, marked by the appearance of anatomically-modern humans (AMH), *Homo sapiens sapiens,* and their distinctive "modern" behaviors and cultural capacities. In Africa, south of the Sahara, archaeologists divide this temporal span into two broad lithic technological traditions: the Middle Stone Age (MSA), ranging from approximately > c. 200,000 to > c. 45,000 years BP, and the Later Stone Age (LSA), ranging from about c. > 40,000 to 7,000 BP (Ambrose

1992; Manega 1993). In other parts of the Old World, the two lithic technological traditions are respectively known as Middle Palaeolithic (MP) and Upper Palaeolitic (UP). The terms MSA and MP on the one hand, and LSA and UP on the other, however, are generally considered to be synonymous (Robertshaw 1995).

The study of the period that witnessed the emergence of our own sub-species (*Homo sapiens sapiens*) has in recent years renewed interest in anthropology. The origin(s) of AMH and their behavioral and cultural roots are perhaps the most immediate scientific issues because they most directly pertain to living people. Nevertheless, many factors continue to plague our comprehension of the biocultural evolution of AMH. The reasons for this are many and varied, including: 1) hominid fossil remains from MSA contexts are few in number, often poorly preserved, and somewhat ill-defined and loosely dated; 2) hominid behavioral and culture-revealing artifacts for the MSA period, other than stone artifacts, are meager and fragmentary; 3) the relationship between biological change and cultural change in the archaeological record of MSA is somewhat unclear and largely inconclusive (at least in some regions); 4) the timing and basic processes of either biological differentiation and speciation leading to the emergence of AMH or behavioral and cultural (e.g., techno-typological) transition from MSA to LSA, or both, are somewhat unclear; and 5) individual differences in theoretical, methodological, and

interpretative approaches to the fossil hominid, archaeological, palaentological, chronological, and genetic records. Consequently, many important data are being either contested or merely dismissed in evaluating competing theories and hypotheses on the biocultural origin(s) of our own sub-species. In the following sections, I isolate and summarize the major issues debated about the biocultural evolution of *Homo sapiens*.

AMH Origin(s): Competing Hypotheses

The morphological and spatio-temporal origin(s) of the earliest remains of AMH have been described by palaeoanthropologists and geneticists in very different ways. Most of the current palaeoanthropological literature on the subject can be divided into at least two competing hypotheses. The "Recent African Origin" (RAO) hypothesis posits an initial appearance of AMH in Africa before 100,000 BP, and then dispersing throughout the world with an early thrust into the Levant. According to this view, the emergence of AMH is seen as a "dramatic" or "punctuated" evolutionary event (see Gould and Eldredge 1977), involving some form of large-scale population dispersal (and eventual replacement) deriving ultimately from Africa.

The "Regional Continuity" (RC) hypothesis posits multiple origins for AMH from late *Homo erectus* ancestors throughout the Old World. Accordingly, hominid evolutionary events are seen as essentially "continuous" and "gradual"

(see Cronin et al. 1981), populations of late (developed) *Homo erectus* are succeeded by local *Homo sapiens* in an unbroken progressive fashion. Few if any groups become extinct. Subsumed within these two basic hypotheses are four variants (Aiello 1993): 1) the African replacement model (Stringer 1989, 1992; Stringer and Andrews 1988); 2) the African hybridization model (Bräuer 1984, 1989, 1992) that favors the RAO hypothesis; 3) the assimilation model (Smith 1992); and 4) the multiregional model (Frayer et al. 1993; Thorne and Wolpoff 1992; Wolpoff 1989, 1992; Wolpoff et al. 1984) that favors the RC hypothesis. As examined here briefly, there are disagreements among palaeoanthropologists on the analytical techniques and interpretations of the fossil hominid, archaeological, and chronological records (see Stringer and Bräuer 1994), despite Lieberman's (1995 and comments therein) and Klein's (1995) recent attempts to arrive at a balanced appraisal of the competing hypotheses. It will be useful now to turn to human genetic anthropologists.

The search for the origin(s) of AMH has in recent years taken a "new" scientific course. For the first time in the history of human evolution, geneticists have been able to trace the genetic roots of the *Homo sapiens* family by analyzing "modern" mitochondrial and nuclei DNA (mtDNA and nDNA). These genetic studies have indicated a clear genetic separation between African and non-African "modern" populations. Contemporary Africans have been found to

exhibit the greatest diversity in mitochondrial and nuclear DNA, providing important insights into the origin of AMH. The molecular data from mitochondrial and nuclei DNA have been interpreted to indicate that all "modern" people evolved from a single common ancestor who lived in Africa about 200,000 BP (Cann et al. 1987; Stoneking and Cann 1989; Stoneking et al. 1986; Vigilant et al. 1991; Wainscot et al. 1986). This interpretation has fueled the debate on the origin(s) of AMH and has been challenged by other molecular anthropologists (Hedges et al. 1992; Templeton 1992). What is needed to resolve the genetic data, according to Hedges et al., is DNA sequence data from multiple nuclear genes, in combination with the mtDNA data. A more recent study has traced for the first time the genetic roots of the *Homo sapiens* family through male descent, by analyzing the Y chromosome. This study also points to an African individual or population that is exclusively ancestral to all "modern" humans (Pääbo 1995).

The problem of origin(s) of AMH is certainly going to continue to crop up given the fragmentary and inconclusive nature of the evidence. Similarly, our conceptual understanding of the basic processes of hominid differentiation and speciation during the Late Quaternary is poor. On the basis of the available information concerning the fossil hominid, archaeological, chronological, genetic, and present and past ecological record, Africa remains a strong case for the location of the world's earliest AMH (see

also Klein 1995). The consistent occurrences in Africa of the potentially earliest AMH cannot be simply ignored. Nonetheless, Africa's hominid sample size, when compared with other regions (e.g., the Levant), is small, often fragmentary, and loosely dated. As noted earlier, one goal of the research reported in this dissertation was to correct this condition by recovering additional hominid fossil material to increase both the quality and the sample size of African Late Quaternary hominid fossils.

Capacity for Modern Human Behaviors and Culture: Competing Hypotheses

The question of the emergence of AMH during Late Quaternary times is often linked to the question of the origin(s) of "modern" human behavior, despite many difficulties in deciphering the behavioral patterns that define "modern" behavior in the first place. General biological evolutionary principles suggest that there should be behavioral correlates for the emergence of a new hominid species. These hominid behavioral distinctions and shifts could include resource exploitation, technology, land-use, and social organization (Foley 1989). Few archaeologists will disagree with Foley, yet, there have been some disagreements among archaeologists as to when in time this shift really occurred. Some scholars contend that such behavioral shifts were evident during the MSA. In contrast,

others assert that such behavioral change did not take place before the transition from MSA to LSA.

It is generally agreed that it is the transition from MSA to LSA that marks a major shift in AMH behaviors and adaptations. Some archaeologists argue that after this transition, the record of LSA foragers meet the criteria for culturally "modern" including 1) declarative planning (Stiner and Kuhn 1992); 2) more efficient design and organization of lithic technology (Binford 1989); 3) more efficient means of food procurement and processing (Binford 1984; Ambrose and Lorenz 1990); 4) more structured social relations among groups for exchange of information and mates (Gamble 1986); and 5) symbolic cognition (Byer 1994; Chase 1991; Davidson and Nobble 1993; Hyden 1993; Lindly and Clark 1990; Noble and Davidson 1993). According to this view, these expressions of behavior appeared "abruptly" and were "universal" in nature, and were, therefore, the careers of "modern" humanity across the MSA/LSA transition.

Supporters of the above view often cite the lack of artifactual evidence indicative of "modern" behavior during the MSA. The lack of behaviorally and culturally revealing evidence is then used to argue that although MSA foragers were anatomically and cognitively human, their behaviors and cultures were not, implying that MSA AMH were cognitively pre-"modern" (Klein 1995). Two important considerations arise at this juncture. First, if MSA hominids were as anatomically-modern as in the LSA, then there should be no

major behavioral differences between them, regardless of the temporal span (e.g., MSA and LSA). Second, if both MSA and LSA hominids were anatomically-modern and there were behavioral differences between them, then the overall expressions of behaviors that are assumed by some to be the career of "modern" humanity during the LSA lagged behind "modern" anatomical evolution during the MSA. This implies that the transition from *Homo erectus* to AMH during the MSA was "abrupt" or "punctuated" and, for the first time in hominid biocultural evolution, we see a decoupling of biological and cultural evolution. Empirical evaluations and explanations of this biocultural decoupling are rare. Similarly, empirical testing of the "modern" behavioral and cultural aspects for the MSA and LSA hominids in an adaptive framework is lacking.

Klein (1995) has suggested recently that the increasing component of "modern" behavior during the LSA (about 50,000 BP) was due to a neural change that promoted the extraordinary "modern" human ability to innovate. Yet, Klein do not explain the conditions that favored the neural change during the LSA. From an evolutionary perspective, I argue that, it is important to understand the conditions that selected for either the neural change or an increasing component of "modern" behaviors during the LSA.

Other archaeologists argue that although "new" cultural and behavioral manifestations appeared in the LSA, these innovations evolved "gradually" and were rooted in the MSA,

where they existed in embryonic stages (Deacon 1989; Deacon and Geleijnse 1988; Marshack 1989; Mellars 1989). These scholars note that the assumptions of LSA behavioral and cultural patterns as relevant scales to measure MSA hominid behavior and culture may be biased and misleading because of the different taphonomic natures of the two records. Proponents of this position argue that lack of symbolic evidence during the MSA is itself a circular argument--it lacks force as it cannot falsify anything. Moreover, they argue that, although fragmentary and contested, there is ample evidence of "modern" behavioral and culture-revealing data from MSA contexts. Therefore, the differences in behavior and culture between MSA and LSA hominids may be more of *degree* rather than *kind*.

Supporters of behavioral "continuity" observe that in most parts of the world there is no "abrupt" techno-typological transition and that the much discussed European transition has limited regional and archaeological implications rather than a universal evolutionary validity. This argument is particularly relevant to our understanding of hominid behaviors and culture during the MSA and at the MSA/LSA transition in sub-Saharan Africa. Unfortunately, our knowledge of hominid behaviors and culture in sub-Saharan Africa during this time span is extremely poor (Clark 1988; McBrearty 1988; Marean 1990) for the following reasons.

Varying rates of culture change. Investigating the competing hypotheses of "modern" hominid behavior and culture

("gradual" vs. "abrupt" or "punctuated" equilibrium) at the MSA/LSA transition is problematic because: 1) evidence of occupation at many sites directly following the latest MSA is lacking; 2) the techno-typological and temporal location of the MSA/LSA transition is unclear; 3) the cause or causes of the transition are unknown; and 4) how the transition relates to the appearance of "modern" behaviors and culture or the emergence of cognitively "modern" humans is ambiguous.

Regarding a lack of occupation directly following the latest MSA, there are sites in northern and central Tanzania (Kisese II, Mumba, and Nasera rock shelters), southern Kenya (Lukenya Hill-GvJm46, Enkapune Ya Mto), southern Somalia (Burr Heybe), and southern Africa that suggest the presence of "transitional" industries with minimal or no stratigraphic breaks between the MSA and LSA levels (Brandt and Gresham 1989; Carter et al. 1988; Inskeep 1962; Kaplan 1989; Mehlman 1989; Merrick 1975). Archaeologists have shown that the shift in techno-typology at these sites was not "abrupt", but rather "gradual" or at least "mosaic" in nature. Even the "typical" LSA typological characteristics at these sites, and many others in Sub-Saharan Africa are accompanied by MSA technological characteristics (e.g., dominant production of flakes, some of which have faceted platforms; see Thackeray 1992). At other sites, there are blade- and microlithic-rich assemblages (e.g., Howeison's Poort and Umguzan Industries) that appear before or interstratified with flake-rich ("typical") MSA assemblages. The basic question then is,

where does the MSA/LSA transition lie in terms of techno-typological changes? Others would like to place the "transition" at the appearance of worked bone tools. Nonetheless, recent studies by Brooks et al. (1995) and Yellen et al. (1995) of bone tools from Zaire's Upper Semliki Valley preclude such thinking. In retrospect, Late Quaternary lithic assemblages in south and east Africa show that the processes of techno-typological transition from MSA to LSA were "gradual" and the changes occurred individually and idiosyncratically (see also Thackeray 1992). At many sites, the "old" ways of doing things were irresistible so that we find "typical" LSA assemblages evidencing "typical" MSA techno-typology. This shows that the Late Quaternary archaeological record in sub-Saharan Africa is more complex, characterized by progressions consisting of elements of both "continuity" and "change".

As far as the temporal location of the MSA/LSA transition is concerned, the picture is also muddled. There is increasing evidence to indicate that early "typical" LSA assemblages appeared in East Africa about 45,000 BP, if not earlier (Ambrose 1992; Manega 1993). If these recent dates are correct, then the MSA/LSA transition occurred much earlier in East Africa, predating 40,000 BP. In southern Africa (south of the Limpopo River), the early "typical" LSA also may date to about 40,000 BP (see reviews by Thackeray 1992; Wadley 1993 and references therein). However, the MSA/LSA transition occurs at Umhlatuzana rock shelter about

30,000 BP (Kaplan 1989, 1990). At some sites in southern Africa, the MSA persisted during "typical" LSA times, ending about 20,000 BP (Thackeray 1992). From the foregoing summary of the temporal spans of MSA and LSA occurrences, it is clear that there may not be an exact time for the MSA/LSA transition in sub-Saharan Africa.

Evidently, there are major problems regarding the temporal spans of MSA, MSA/LSA, and LSA assemblages in sub-Saharan Africa. As noted earlier, this may reflect a lack of sites with long and continuous archaeological sequences that are also well dated. As Thackeray (1992) notes, however, there seems to be little disagreement that MSA sequences at some sites in southern Africa ended about 20,000 BP. Indeed, I agree with Thackeray that this indicates a longer duration of MSA occurrences in some parts of sub-Saharan Africa.

This assertion, however, begs many fundamental questions. Why was this so? Were the southern Africa makers of MSA of the 20,000 BP *isolated* from and unaware of the pre-20,000 BP LSA people, their culture and technology? Were the 20,000 BP MSA people neuraly and cognitively "archaic" and, hence, fundamentally incapable of fully "modern" behaviors and culture? If 20,000 BP MSA people were anatomically "modern" but neuraly and, hence, cognitively "archaic", then, how can this be related to the arrival of "modern" behaviors or the emergence of cognitively "modern" humans at the MSA/LSA transition if this occurred about 50,000 BP? Did the 20,000 BP MSA people become extinct or were they replaced

like the Neandertals because they could not compete culturally with different LSA people? Is the MSA/LSA transition a *real* archaeological phenomenon that can be empirically observed, measured, and explained, or is it a purely analytical abstraction of archaeologists? These are major puzzles whose solutions are important for our understanding of MSA and LSA hominid behaviors and culture in sub-Saharan Africa. Obviously, archaeologists can learn at least one lesson from the southern Africa data. If the previously observed techno-typological overlaps between MSA and LSA assemblages are any indication, why should there not have been overlaps in other aspects of culture and behaviors?

Concerning the cause(s) of the MSA/LSA transition, physical (environmental change) and social (cultural) selections are either invoked respectively or together to explain the MSA/LSA transition (Mitchell 1988; Kaplan 1989; Parker and Milbrath 1993). It is still unclear, however, how changing ecological conditions, social relations, or both of these factors articulated with techno-typological and behavioral changes. This is because archaeologists have not seriously attempted to explain the selective pressures that would have favored techno-typological and behavioral changes in the first place.

Meaning of lithic assemblages. One of the more noteworthy features of the MSA throughout sub-Saharan Africa is its inter-assemblage lithic variability. Broadly speaking, MSA Industries in sub-Saharan Africa are typified

by the emergence of specialized retouched flake and flake-blade technologies struck increasingly over time and space from smaller and more refined prepared cores (see Clark 1988; Thackeray 1992). Of the shaped tools, uni- and bi- facial points, scrapers, and denticulates are characteristic.

The MSA, transitional between the Early Stone Age (ESA) and LSA, appropriately evidences aspects of "continuity" and "discontinuity" with both. Nonetheless, scholars distinguish the MSA from the former by a general lack of large bifacial tools (handaxes and cleavers), the *fossiles directueurs* of the Acheulian and from the later by an absence of microliths (backed blades and geometric forms) that are the hallmarks of the LSA (Clark 1988). These techno-typological distinctions are, at variance, however, since some assemblages (e.g., "Sangoan"/"Njarasan") that are at least tenuously linked with the MSA (Clark 1988; McBreaty 1988; Mehlman 1989) include large cutting tools (bifaces and core scrapers) while others (e.g., the "Howeisons Poort," "Umguzan") include blades (Thackery 1989; Singer and Wymer 1982). Also, some MSA assemblages do not exhibit a large proportion of prepared core platforms.

Evidently, assemblage variation exists within and between the MSA (Allsworth-Jones 1986; Clark 1988; Volman 1984). The meaning of such variability remains largely controversial. Past interpretations have centered on a "culturalist" position in which variability is seen as a result of cultural tradition or style (Bordes 1973). Clark

(1988), for example, notes that the wide range of MSA tool types in sub-Saharan Africa provides the first clear evidence for regional (ecological) variability and the beginning of cultural identities. Others take a "functionalist" position in which the same lithic variability is considered to be the result of different artifact functions and activity sets (Binford 1973). Accordingly, if there are regional variabilities in the MSA industries, they are not the product of cultures, styles, or ethnic groups. Yet, functional explanations do not account for the diversity within a single category of tool. For example, why are there so many forms of scrapers within a single MSA assemblage?

Recent lithic studies outside sub-Sahara Africa consider a range of issues that might have caused lithic variability during the MSA. These include patterns of core reduction (including the personal skill of the artisan); raw material availability, acquisition and selection; tool use and discard; and the aesthetic demands of the ethnic group (see Nelson 1991). Wiant and Hassen (1984) note that the "culturalist" and "functionalist" approaches to account for variations in lithic assemblage are limited because they do not consider lithic technology from a broader technological perspective incorporating an understanding of the organizational principles of lithic technology. Unfortunately, technological studies for the MSA lithic assemblages in sub-Saharan Africa are few. The most fundamental level of identifying MSA assemblage variability

however, should be the spatio-temporal variation. It is imperative to approach MSA lithic technology and typology from a regional perspective, utilizing the knowledge of techniques of production and utilization from experimental studies. The lithic technology and typology of MSA may not have been "one" at all as it may have changed in different ways at different times and places. Alternatively, our assumptions underlying the technologies and typologies of MSA lithic assemblages are inadequate for characterizing the human meanings the patterns manifest (see also Thackeray 1992).

Hominid biological versus cultural change. As for the correlation between human anatomy and culture change, the Late Quaternary archaeological record in sub-Saharan Africa is somewhat unclear when compared to that of Europe. In Europe, with a few exceptions, the evolutionary change in hominid anatomy and culture coincide (Smith and Ahern 1993), so that anatomically-modern *Homo sapiens* are associated with UP assemblages, whereas Neandertals are associated with MP assemblages.

In East Africa, remains of anatomically-archaic *Homo sapiens* (e.g., Eyasi crania) are associated with a heavy-duty toolkit that combine both MSA and late Acheulian features. This lithic industry is known as "Sangoan" or "Njarasan" (MacBrearty 1988; Mehlman 1989; Chapter 3). Fossil remains of early anatomically-modern *Homo sapiens* in sub-Saharan Africa are associated with both "typical" MSA and LSA

assemblages. Evidently, the sub-Saharan evidence shows that the pattern in both hominids and stone tool techno-typologies appears to be one of "gradual" development, without "sharp" breaks (Allsworth-Jones 1993).

MSA vs. LSA subsistence behavior. The evidence for subsistence behavior during the MSA is sparse and fragmentary. This is especially true in eastern Africa, although this may also reflect a lack of research on the MSA. The bulk of data on MSA subsistence behavior in sub-Saharan Africa comes from southern Africa. These include the faunal remains of mammals, molluscans, plant remains (e.g., charred seeds or nuts, hephytes), and stone artifacts (e.g., grindstones) (see Thackeray 1992 and references therein).

The analyses and interpretations of this evidence have generated some controversies over whether MSA AMH were also "modern" in their subsistence behavior like that of LSA people. For instance, in his examination of the Klasies' fauna assemblages, Klein identified two modes of faunal exploitation: the selective hunting of individuals, very young buffalo specimens, and the group-harvesting of elands (1976). Klein's analysis of the Klasies' faunal indicates incipient hunting by MSA hominids. Other researchers have interpreted the plant data found in MSA contexts to indicate systematic and organized foraging systems similar to "modern" foragers. For example, plant (corm scales of *Watsonia* sp. and a *Tritonia-Freezia* corm tunic) remains found in distinct patches near hearths at Strathalan Cave B suggest that the

occupants prepared their food in a manner similar to LSA people (Opperman and Heydenrych 1990; Thackeray 1992). Deacon (1989) has argued that carbonized lenses in the Howeison's Poort levels at Klasies represent the burned residues of geophytes. He notes that MSA subsistence strategies at Klasies sites may have involved systematic burning of the local vegetation to encourage the growth of the "geophytes", suggesting that MSA people managed their environments and that plant foods formed a major part of their diet. According to this view, most, if not all, of the essential features of subsistence strategies that can be documented among the LSA populations can be traced back to the MSA. In any case, Deacon (1989; Deacon and Geleijnse 1988) envisages "continuity" and "similarity" in hominid subsistence behavior between the MSA and LSA.

The above view of "gradual" change in hominid subsistence behavior between the MSA and LSA has been challenged by other scholars. Binford's (1984) rather brief study of Klasies' faunal led him to observe that small animals were hunted while larger ones were scavenged. Binford then concluded that MSA people obtained most of their animal protein from subsistence practices of scavenging rather than hunting. Klein (1989) has in recent years re-examined the southern Africa faunal data (including Klasies) and found that most meat was obtained by hunting, with the caveat that MSA sites are richer in vulnerable individuals or docile species such as the eland, while they are poor in the

more dangerous game species such as the Cape buffalo. This pattern has been interpreted to indicate that MSA behavioral subsistence skills were "inferior" (less effective hunters of large and more dangerous species of game animals) to those of LSA people. Likewise, Klein (1989) and Marean (1986) observe that MSA people did not exploit seals like LSA people did, suggesting that MSA people were unaware that seals could be hunted or scavenged easily on a seasonal basis.

The lack of evidence for the utilization of fish and flying birds in MSA contexts (contra LSA) is also often cited to indicate considerable differences in subsistence behavior between MSA and LSA people. Ambrose and Lorenz (1990), who consider MSA hominids from Klasies to be anatomically-modern, devised a socio-ecological model to explain variations in behavioral and subsistence strategies between the MSA and LSA. They concluded that MSA people, although anatomically-modern, simply lacked the "software--the cumulative body of knowledge and tradition required to make effective use of a technology that was not yet invented" (1990, p. 28).

Thackeray (1992) observes that there could be reasons other than behavioral backwardness that MSA people did not exploit all the resources LSA people did. Several sites in southern Africa, for example, document the oldest known evidence for the systematic exploitation of shellfish (Brink and Deacon 1982; Grine et al. 1991; Voigt 1982; Volman 1978). Also, MSA people in southern Africa utilized tortoises, although less intensively when compared to LSA times (Klein

1989). At Katanda, Zaire, abundant faunal remains of catfish and mammals have been found in direct association with MSA and worked bone artifacts (Yellen et al. 1995). The worked bone artifacts include both barbed and unbarbed points as well as dagger-like objects. Dating both by direct and indirect means indicate an age of about 90,000 BP for the faunal remains, MSA stone and worked bone artifacts (Brooks et al. 1995; Yellen et al. 1995). This pattern has been interpreted to indicate that a complex subsistence specialization had developed in sub-Saharan Africa during the MSA. The level of behavioral competence required is consistent with that of LSA people (Yellen et al. 1995). The differences in subsistence behavior between MSA and LSA at some sites, therefore, lie in how foraging systems were organized rather than in capabilities or behavioral potentials (Thackeray 1992).

MSA vs. LSA symbolic and social behavior. One glaring characteristic of the MSA is the distinct lack of truly social and symbolic-revealing artifacts. In sub-Saharan Africa, the only examples of symbolic artifacts from the MSA are sharpened bones from Klasies, a few painted stone pieces, and incised ostrich eggshell fragments from Apollo 11, an infant burial associated with a perforated *Conus* shell at Border Cave, and bits of ochre and hematite from various sites (see Clark 1988; Thackeray 1992). These symbolic and social features became more apparent during the LSA.

Focusing on Eurasian data, some archaeologists have suggested that the foundations of "modern" forager behavioral repertoire emerged at the MP/UP (MSA/LSA) transition. They argue that before this transition there is no convincing evidence for the organization of behavior according to symbolic codes (Chase and Dibble 1987; Davidson and Nobble 1993; Hyden 1993; Lindly and Clark 1990; Noble and Davidson 1993). The view that AMH who produced "typical" MSA assemblages were "non-symboling" creatures has also been argued by Chase (1991) and Byers (1994). The theoretical as well as the empirical implications of this view have been that symbolic behavior emerged "suddenly" at the MP/UP (MSA/LSA) boundary. Nonetheless, the relationships between symbolic behavior and symbolic intelligence during MSA times remain more controversial.

At the other end of this debate, some archaeologists argue that just because there is flimsy evidence of symbolic behavior during the MSA, this does not prove that MSA people lacked the ability to symbol (Bednarik 1992; Deacon 1989; Marshack 1988, 1990; Mellars 1989). These scholars argue that the occurrences of sharpened bones, painted stone pieces, ostrich eggshell beads, incised ostrich eggshell fragments, the infant burial associated with a perforated *Conus* shell, and bits of ochre and hematite from MSA contexts in Africa and Eurasia empirically demonstrate symbolic behavior. Using neo-Darwinian evolutionary theory, Knight et al. (1995) argue that symbolism arose as a response to

increasing levels of productive stress experienced by females during the rapid phase of encephalization associated with "archaic" *Homo sapiens*. Proponents of this view acknowledge that the MSA did not share in the elaboration of symbolic behavior witnessed in the LSA. Nevertheless, all the essential elements were in place by, or shortly before, "typical" MSA--approximately coincident with the emergence of AMH.

Thackery (1992) points out that the paltry symbolic evidence we observe in the MSA may be because MSA symbols took forms that were not preserved in the archaeological record or were undeveloped because of conservatism and lack of innovation under low-density demographic conditions. This perspective envisages a "gradual" emergence of symbolic and other human social behaviors. As long as we do not know what kinds of selection pressures that could have *exactly* favored the first production of symbolic behavior during the MSA or its elaboration during the LSA, this debate will continue.

Lack of regional research on the MSA and LSA. Bower (1986) observes that regional spatial data on the MSA and LSA are very sparse in sub-Saharan Africa. Broad-based, regional studies aimed at recovering distributional data for MSA and LSA foragers and providing direct insights into the exploitation of resources and human-land use patterns are significantly absent in Eastern Africa. This is not an uncommon problem in African archaeology, where the amount and quality of research are often irregular. In the absence of

systematic investigations of MSA and LSA to recover new data, behavioral interpretations of the current archaeological material remain at best tentative. An important aim of this dissertation is to address these concerns within the context of cultural ecology and landscape archaeology.

Theoretical Considerations

Scientists often rest their research upon a set of assumptions. These assumptions define the research problem, theories, methods, and the kinds of data relevant to the investigation (Kuhn 1962). The goals of the following sections are to 1) outline the theoretical approach that has guided this research; 2) define the overall research strategy; and 3) to construct ecologically derived models of the potential land-use of the Eyasi Basin by MSA and LSA foragers. This approach is distinctive because most often theoretical assumptions and model building receive little attention in East African MSA and LSA archaeology (Robertshaw 1995).

The research assumptions that underlies this study is a combination of cultural ecology and a spatial approach. As viewed in this research, this orientation focuses on the interactions between people and elements of the landscape. These interactions often result in patterns of behavior that are imprinted upon the landscape and that can be investigated spatially. Central to this ecological-spatial approach is the concept of adaptation. This approach is germane for

understanding the relationships between space, time, landscape, and foragers during the MSA and LSA in the Eyasi Basin. In examining the distribution of MSA and LSA material across the landscape, it should be possible to demonstrate, for example, how MSA and LSA foragers, regardless of the temporal span, adapted to regional landscapes and ecological conditions. A lack of such an archaeological approach has meant that we know very little about MSA and LSA forager spatial behavior in East Africa.

In the following sections, I review the theory of cultural ecology, the concept of cultural adaptation and the spatial approach I deem relevant for investigating MSA and LSA foragers spatial behaviors in the Eyasi Basin.

Cultural Ecology/ Ecological Theory

Theories that seek to explain the relationships between humans and their environment have in recent years made important contributions in anthropology. The origin(s) of these theories, however, go beyond the beginning of anthropology as a discipline to the time of the ancients. Moran (1979) painstakingly traces theories of this sort to the ancient Greeks. In the early formulations at least three themes characterized theories of environmental influence. These include: 1) environmental determinism; 2) possibilism--environment as a limiting factor to human possibilities; and 3) human adaptation to the environment (Moran 1979). The underlying feature of these early ecological approaches is

the view that the interactions between humans and their environments were unidirectional, rather than systemic (Moran 1979). Depending upon one's approach, either environmental or cultural factors were perceived not as causative but rather as setting limits for the interactions between humans and their environments (Grossman 1977; Moran 1979). As Moran correctly observes, these early ecological approaches emphasized stages in human adaptations, rather than processes (Moran 1979).

From the 1930s to 1950s Julian Steward introduced the theory of cultural ecology. He proposed that under certain environmental conditions the organization of subsistence and technology gives rise to certain patterns of behavioral organization (1955). His major goal was to show how technology, subsistence, and environment are reflected in foragers' adaptive behaviors (1955). In this endeavor Steward emphasized the manner (processes) in which the environment's resources were utilized by foragers. Steward's cultural ecology was influential in establishing an ecological approach to forager research grounded in a solid understanding of local environments (cf. Lee and DeVore 1968).

During the early 1960s, however, some scholars became dissatisfied with the research approach of cultural ecology. The critics of cultural ecology increasingly sought theoretical advice outside anthropology and found contemporary work in ecology more appealing. It became

apparent that by studying humans as parts of larger ecosystems, attention could be given to human adaptations--biological, cultural, and behavioral (Bennett 1976; Hardesty 1980; Vayda and Rappaport 1968). Consequently, the ecological concepts of ecosystem and homeostasis were then adopted in anthropology, particularly in research programs focused upon foragers (see Moran 1979). As Bettinger (1991) notes, such research envisioned homeostasis as the natural and predictable end product of cultural process and reduced the explanation of behavior and ideas to homeostasis. Also group selection, that is, "the idea that human behavior originates and is justified at the level of the group, social system, or culture rather than at the level of the individual" (Bettinger 1991 p. 50) became important. Therefore, human, and forager behaviors in particular, had to be explained in terms of adaptation. Research guided by middle-range theory, the limited theory through which ecological approaches have been applied to forager archaeology and ethnography, frequently incorporates the concept of adaptation (Binford 1979, 1980).

Although some scholars have argued for a unified theory of ecology, Bennett (1976) finds no real distinction between cultural ecology and the ecosystem approach. Current ecological approaches, however, tend to dissent from both cultural ecology and the ecosystem approach as some researchers have sought refuge in neo-Darwinian evolutionary ecology (e.g. Bettinger 1991; chapters in Smith and

Winterhalder 1992a). Evolutionary ecologists attempt to understand human behavior in terms of genetic fitness (Bettinger 1991; Richerson and Boyd 1992; Smith and Winterhalder 1992b; Winterhalder and Smith 1992). Evolutionary ecology has not yet been able to establish a direct link between genetic fitness and particular kinds of behavior, despite Foley's efforts (1992). Consequently, evolutionary ecology has focused on posing questions in economic terms (Parker and Mynard Smith 1990). Out of necessity, research guided by optimal foraging theory, the limited theory through which economic decisions (cost/benefit) are made, have been part and parcel of the research programs of evolutionary ecologists (Hawkes 1992, 1993; Kaplan and Hill 1992; Smith and Winterhalder 1992b, to mention a few). Individual selection, that is the idea that human behavior originates and is justified at the level of the individual rather than at the level of the group is the focus of evolutionary ecology in the analyses of human behavior (Smith and Winterhalder 1992). However, the primary difficulty of applying evolutionary ecology to the study of MSA and LSA *Homo sapiens* behaviors is to place their material remains into a cost/benefit framework where the conditions for the appearance of behavioral traits can be specified.

Despite it's radical approach, evolutionary ecology can be seen in my opinion to be rooted in a tradition of ecological and materialist explanations that extend back to Steward. Moreover, evolutionary ecology, cultural ecology,

and the ecosystem approach unite by invoking the concept of adaptation in the analyses and explanations of the interactions between environments and organisms. Basically, these ecological approaches focus on the analysis of a human's biological and behavioral adaptive strategies and the processes of the interactions between humans and the landscape's elements. This focus is a key to understanding the "when", "how", "where", and "why" questions about MSA and LSA forager spatial positions in the Eyasi landscape. By placing the main emphasis on the interactions between people and elements of the landscape, ecologically oriented research begins with a processual approach (Young 1974).

Adaptation

All archaeologists agree that culture and biological design provide humans with the means to adapt to the elements of the landscape. Adaptation is, therefore, a useful concept that can be used to investigate variabilities in human behaviors, culture, and biological design both in time and space. It is the means by which human-environment relationships develop. Therefore, adaptation can be used to account for changes in past human behaviors and culture.

What archaeologists disagree about, however, is the role adaptation plays in cultural evolution. Archaeologists and anthropologists of cultural ecology and ecosystem persuasions view adaptation as a process whereby humans actively and intentionally direct change in their strategies and tactics

of survival. Taking this perspective, Bennett (1984, p. 246), for example, defines adaptation as a "set of psychological processes which are probably universal or nearly so, and a set of novel behavioral responses adapted to particular times and situations". To Bennet, adaptation is a product of the interactions between particular historical processes and human institutions. According to Hardesty (1986), cultural adaptation occurs because of changes in technology, organization, and ideology, in short, all aspects of culture. To Denevan (1983, p. 401), adaptation is "the *process of change* in response to changes in the physical environment or a change in internal stimuli, such as demography, economics, and social organizations." Conceived in these ways, adaptation is a consequence rather than a force in cultural change or stability.

In contrast, evolutionary ecologists and archaeologists take a biological perspective of adaptation. According to this view, adaptation is a product of selection (Bettinger 1991; Dunnell 1980, 1989; O'Brien and Holland 1992; Smith and Winterhalder 1992b; Teltser 1995). In accordance with this approach, Kirch (1980) views adaptation as the continuous modification of learned behavioral patterns in response to changing elements of the landscape by means of the selective retention of behaviors that confers "fit" upon members of a society. Conceived in this way, adaptation is dependent on selection.

I suggest that adaptation as a strategy and tactic for human survival can be investigated using any number of approaches (scales) depending upon the 1) research problem; 2) methods; and 3) the nature of the archaeological record. Accordingly, for the purpose of this dissertation, I view adaptation from the cultural ecology and ecosystems perspective.

Inferences about the nature of adaptive relations in archaeological contexts often are difficult to make. It seems reasonable to assert, however, in the case of MSA and LSA foragers, that subsistence, land-use/mobility patterns, and technology will have the most evident archaeological consequences for adaptive strategies and tactics. In this dissertation, these will be measured using artifact assemblages, types of raw material, reduction sequences, distributions of artifacts across the landscape, exchange/trade, and so forth. Although faunal remains were recovered, fauna data is not considered due to time constraints.

The Spatial Approach

Traditionally, archaeologists accomplish their investigations by giving higher priority to the densest and most conspicuous artifact or bone concentrations (usually known as "sites"). Within this conceptual framework, sites are taken as the basic units of investigations and analyses, and are regarded as self-evident loci of past human

activities (Dunnell 1992; Ebert 1992). Consequently, low density scatters and single artifacts are often considered less important in archaeological investigations and interpretations. This is a common approach in East African archaeology, where culture-history has dominated research (Robertshaw 1995; see Chapter 3). A major limitation of this normative approach is that it focuses on single settlements rather than looking at the dynamics between settlements on a regional landscape, or the relationship between a human habitation and the use those humans made of the broader landscape (Mabulla and Reid 1993).

As important as this normative approach is for establishing cultural affiliations, it is inadequate in documenting forager adaptive strategies. In particular, the "site" approach has limited the potential of recovering data in East Africa on MSA and LSA forager organization of technology and spatial behavior, as reflected by the distribution of artifacts and other items of material culture across the landscape. Indeed, artifacts, ecofacts, and features that discern the spatio-temporal distribution across the landscape are the kinds of data that can be used to interpret precisely the cultural patterns that differentiate modern *Homo sapiens* having an MSA technology from those having an LSA technology. Understanding MSA and LSA forager spatio-temporal behaviors represents an important means of reconstructing meaningful past forager lifeways. In other words, meaningful ways of life led by foragers cannot be

fully understood by solely investigating sites. This is especially true since foragers had landscape-based strategies rather than site-based land-use and adaptive strategies.

Furthermore, major changes in hominid adaptations, seen as changes in anatomy, behavior, subsistence strategies, and technology, never took place at a single site. Such changes may be reflected at one site through time, but the scope of the processes involved are broader, involving the entire landscape. One task for landscape archaeologists is to investigate and explain these broader forager adaptive systems as manifested in the archaeological record.

Archaeology has recently developed numerous strategies for examining the spatial dimensions of the archaeological record, particularly through regional research and analytical and surface survey techniques. Such an approach has been demonstrated effectively by Thomas's (1975) "non-site," Isaac's (1981) overall "scatters and patches," Foley's (1981) "off-site," Dunnell and Dancey's (1983) "siteless," Ebert's (1992) "distributional," and Blumenschine and Masao's (1990) "landscape" approaches to data recovery and recording in archaeology. A recurrent theme has been the emphasis on studying both low- and high-density scatters of artifacts and their contextual relationships.

Accordingly, surface surveys are now taking on new positive roles in archaeological research and explanation (Bower 1986; Ebert, 1992). Surface surveys and their results have gradually altered the significance attached to single

sites, as they have clearly exposed the arbitrariness and problems of traditional site designations (Bower 1986; Ebert 1992; Dunnell 1992). It is clear, as Ebert and others have shown, that every human activity has its own "space", but the distribution of those activities is in no sense limited to that space and extends irregularly in time and space across the landscape (1992). Intrinsically, "site" as a conceptual category or unit of archaeological investigation and analysis is not optimal for studying prehistoric forager behavior in "space" (Dunnell 1992).

Since the spatial patterning of the archaeological record carries behavioral implications of past human activities, only the continuous distribution of material correlates of past human activities can provide resolutions relevant for investigating forager behavioral patterning. Correspondingly, single artifacts, ecofacts, features, high- and low-density artifact scatters and their contexts (including Schiffer's 1995 c- and n-transforms) are in turn a focus of interest in themselves.

The landscape, as the counterpoint to interactions of humans and their environment, has attracted much archaeological attention in recent years. Landscape archaeology has, emerged therefore, as a research tool for studying past forager adaptive systems and lifeways. Today, landscape archaeologists pursue questions that seek to understand the relationships between landscape, time, space, environment, and culture that might have influenced

prehistoric forager spatial behavior (see chapters in Rossignol and Wandsnider 1992). Evidently, the ways in which people understand and engage their landscape depends upon the specific time, place, environment, and cultural conditions (Crumley and Marquardt 1990).

On the basis of current literature, at least three approaches to landscape archaeology are discernible. First, there is the argument that discarded artifacts and bones, features and ecofacts can be laterally sampled, discerned, and mapped within single sedimentary horizons (Blumenschine and Masao 1990; Isaac et al. 1981; Rogers and Harris 1992; Stafford 1995). Both surface and subsurface archaeological remains and their contexts within the sampled sedimentary unit are subjects of study. This approach is, therefore, practical at areas with visible exposed sedimentary structures that can be stratigraphically recognized and horizontally marked.

The second approach studies the distribution of archaeological material across the regional landscape by incorporating the regional ecological and geomorphological variables and ethnographic or actualistic studies (Ebert 1992; Foley 1981; Rossignol and Wandsnider 1992). In this perspective, interest is directed toward the determination of regional forager adaptations and land-use patterns through the surface distribution of artifacts, their interrelationships, and their ecological and geomorphological contexts (Dunnel and Dancey 1983). This approach has become

a driving force toward the growth of archaeological surface survey and its legitimization as a reasonably independent methodology capable of generating information unparalleled by excavations (Bower 1986; Dunnel and Dancey 1983; Ebert 1992). Likewise, interests in exploring prehistoric forager spatial behavior (e.g., social, economic, ecological), along with goals for archaeological heritage management, have increasingly required surface survey of regional scales (Ammerman 1981; Dunnell and Dancey 1983). As will be shown later, this dissertation follows this second approach to landscape archaeology.

The third approach combines one or both of the previous two approaches with Geographic Information Systems (GIS) (chapters in Allen et al. 1990). The combination of landscape archaeology and GIS offers a powerful approach to collecting spatial information on prehistoric foragers and interpreting the cultural and physical structures of landscapes. GIS presents a powerful technique for developing and testing prehistoric forager spatial behavior as it offers functions that allow for the description and analysis of continuous spatial phenomena singularly and in combination (chapters in Allen et al. 1990; Kvamme 1989).

If archaeology's aim is reconstruct the organization of human activities resulting from the relationships between humans and their physical worlds, the ecological-spatial approach is appropriate for such investigations. Theoretically and methodologically, the ecological-spatial

approach provokes archaeologists to identify the distribution of prehistoric human behaviors and their spatial correlates (e. g., ecological, geomorphic, economic, cultural, etc.) across the landscape. Furthermore, it involves conscious selection of broader scales of data observation, collection and analysis, scales that are optimal for understanding forager adaptive systems. It also offers a holistic view that places individual and group behavioral patterns at the center of research (see Chapter 5), and the archaeological record is considered to reflect such structured behavioral patterns. With this perspective, the archaeological record is approached as consisting of various continuous patterns that reflect forager's structured adaptive systems (Ebert 1992). Such organized and structured adaptive systems are investigated in terms of the physical, material, and cultural ways foragers adapted to the landscape.

The Research Approach

As noted earlier in this chapter, ecological theories enable one to generalize empirically about human behaviors and culture by examining the physical (e.g., landscape elements) and cultural (e.g., cognitive, human actions, etc.,) aspects of human survival. This is because distinctive human needs (e.g., food), social relations, and behavioral values are embedded in the cultural system, along with distinctive landscape features. The latter include ecological (utilized food resources, water, vegetation,

etc.,) and geomorphic (utilized geologic resources and the actual land traversed) conditions. Since both physical and cultural features change at various temporal and spatial scales, their interplay and products also change or evolve at various temporal and spatial scales. An understanding of the processes and the resulting products of the interplay between the cultural and physical features, therefore, requires a spatial approach.

In human foraging systems, for example, climatic factors may induce fluctuation in the geography of food resources. This in turn may induce changes in the spatial positioning of foragers across the landscape. Similarly, as shown in Chapter 5, cultural values or social relations (e.g., sharing of information about the spatio-temporal locations of critical resources, looking for mates, resolving conflicts, reciprocities, etc.,) may also induce shifts in the spatial patterning of foragers. Moreover, the activities of foragers at a particular time and space can adversely affect the available food and other utilized resources, and may force foragers to move away. The challenge of human lives throughout history, therefore, has been to work out adaptive strategies to these dynamics. Bennett notes that:

> as humans deal with the various contexts of existence (which includes social, and mental milieus) they create new problems, so that living becomes a matter of solutions (*adaptive strategies*) to a chain of problems, each solution involving a combination of past precedents and present (*new*) innovations. (1993, p. 47)

As a form of economic activity, foraging may be a complex system involving many economic activities in varying

ways and degrees (Woodburn 1980). In the case of delayed return foragers such as the Hadzabe, the foraging system has the following general features: a subsistence economy largely based on natural ("wild") food resources, social influx, on-going decision making, spatial mobility, simple technology, egalitarian political organization, lack of long-term kinship relationships or social commitments, and low population density (Woodburn 1980). In analyzing these features archaeologically, only the behaviors related to subsistence, technology, and mobility are causally linked to each other and can be said to correlate empirically. Consequently, subsistence, technology, and mobility behavioral aspects were the major tangible cultural strategies of adaptations to the landscape by MSA and LSA foragers. The interactions of these cultural features and the elements of the landscape are of utmost interest to archaeologists of foraging systems as they form the archaeological record we study.

Archaeologically, these methods of forager adaptations can be measured by the utilized faunal and floral remains (Binford 1978; Marean 1990), changes in lithic artifact types and technology, and changes in the spatial positioning of foragers as reflected by the organization of lithic technology and the spatial distribution of stone artifacts (Binford 1979; Kelly 1983; Kuhn 1994, 1995; Shott 1986; Torrence 1983). Since a large body of the data for this dissertation is from the surface, faunal and floral correlates cannot be used to infer MSA and LSA forager land-

use systems. Instead, only the distribution of artifacts and the organization of technology will be used to infer past forager land-use systems and the organization of lithic technology in the Eyasi Basin.

The concept of land-use is somewhat broad, operating at least on two levels: as an "adaptive strategy" and as an "impact" on the landscape. The first refers to the distribution and patterning of forager's activity loci across the landscape. When viewed in this way, land-use is an "adaptive strategy" influenced by technology, spatio-temporal distribution of resources, subsistence, and mobility. This view of the land-use concept provides a valuable insight into the dynamic behaviors behind the distributions of surface artifact scatters. The second refers to the cumulative "impact" of a forager's technology, subsistence, and settlement on the landscape (Kirch 1980). In this dissertation, land-use is viewed as an "adaptive strategy", rather than the "impact" of foragers on the landscape.

The perspective of land-use as used in this dissertation is important, therefore, in seeking to identify the spatial patterning of MSA and LSA foragers through surface survey. One obvious feature of most surveys is the variation in size and density of surface artifact scatters. Such variations can reveal the basic organization of MSA and LSA forager land-use patterns in the Eyasi Basin.

Perspectives on Possible MSA and LSA Forager Land-Use Systems in the Eyasi Basin

In this section, I construct ecologically derived models of forager land-use patterns in the Eyasi Basin during the MSA and LSA times. This is done in order to understand how hominids would have utilized the Basin in response to the available ecological and landscape resources.

On the basis of the available palaeonvironmental data (see Chapter 4), I postulate two climate extremes: arid and humid (Figure 2-1). The arid climate would have a 225 mm mean annual rainfall, 50% less than the modern mean annual rainfall of the Basin (Chapter 4). The humid climate would have a 900 mm mean annual rainfall, 100% more than the modern maximum rainfall in the Basin. These two climatic extremes affected the spatio-temporal distribution of human food resources and potable water, and the availability of refuge (rock shelters) and lithic raw material. Consequently, patterns of hominid movements might be expected to differ in the arid and humid climates. It is important, however, to note that the two climate extremes do not represent the worst case scenario whereby the MSA and LSA foragers would have moved out of the Eyasi Basin to nearby areas such as the Ngorongoro or Mbulu Highlands.

Based upon my field experience in the Eyasi Basin, background reading (Chapters 4 and 5), and discussion with Hadzabe informants, the resources of the Basin can be ranked in their relative importance as follows: potable water > food

resources > refuge availability (e.g., rock shelters) > lithic raw material availability. The last in this list of resources is locally available, however, and evenly distributed in the Eyasi Basin (see Chapter 9). Moreover, it is unlikely that the availability of lithic raw material would have been significantly affected by climatic changes. Consequently, although lithic raw material is an important resource whereby ecological models of forager land-use can be derived, it plays a lesser role in the Eyasi Basin.

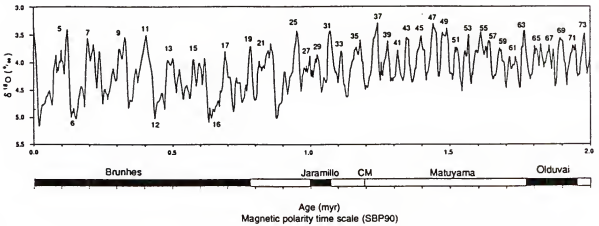


Figure 2-1: Oxygen Isotope Record for the SPECMAP Stack for the Interval 0-2 myr. From Shackleton (1995).

In the arid climate, potable water and food resources would be especially important to foragers as their distribution would be uneven and their abundance reduced. Consequently, forager seasonal and day ranges would variously be affected by the spatial-temporal distribution of potable water and food resources (Peters and Blumenschine 1995). However, in the Eyasi Basin, forager land-use and mobility patterns would be virtually unrestricted by the availability of rock shelters and lithic raw materials during the dry climate.

In contrast, in the humid climate forager mobility and land-use patterns would be virtually unrestricted by potable water and food resources as these would be evenly distributed and locally available. In the Eyasi Basin, however, the availability of rock shelters for refuge would be a determining factor in forager land-use and mobility patterns during the wet climate.

On the basis of the available potable water, food resources, and rock shelter for refuge during the dry and wet seasons, the Eyasi Basin can be divided into four landscape areas. These landscape areas can be relatively ranked as: Landscape Area I (northeast) > Landscape Area II (Siponga-Masiedha Hills) > Landscape Area III (Yaeda-Matala) > Landscape Area IV (Kidero Horst) (Figure 2-2). On the basis of present ecology and landform structures, these four landscape areas would have provided the most reliable resources for forager survival and existence during the two climate extremes.

Arid Phase

During the dry season of the arid climate, the northeast section of the Basin (Landscape Area I; Figure 2-2) would have provided the most opportunities for forager survival. The natural springs, the Mbarai and Endamaghay riverine systems, and the lower slopes of Oldeani, Sadiman, and Lemagrut Mountains would have provided the greatest availability and diversity of food resources and potable

water (Figure 2-3). Foragers would have clustered in the few available rock shelters along the lake shore for refuge. In contrast, all the other landscape areas would have offered little of comparative value for forager occupation (Figure 2-3).

In the wet season of the arid climate, the movements of foragers would have increased, assuming good rains. The foraging group(s) in the northeast would have dispersed and moved further inland to the Siponga-Masiedha Hills (Landscape Area II), Yaeda-Matala area (Landscape Area III), and the Kidero Horst (Landscape Area IV). The Udahya, Endadubu, Yaeda and Sibiti riverine systems would have provided most of the needed potable water inland (Figure 2-3). The Siponga-Masiedha Hills, the Kidero Horst, and the Yaeda Rift Scarps have the highest density of rock shelters (c. 20 rock shelters per km^2) and would have provided needed refuge during the wet season of the arid climate. The inland footslopes and marshlands were extremely important as sources for plant foods (Figure 2-2). Nevertheless, the northeast (Landscape Area I) area would not have been completely abandoned as some old individuals and possibly young children would have remained there.

Humid Phase

The land-use systems of MSA and LSA foragers during the dry season of the humid climate would have been similar to that described previously for the wet season of the arid

climate. In contrast, during the wet season of the humid climate, rock shelters are the limiting factors in land-use patterns. The lacustrine plains in the northeast would have been inundated, flooding the nearby potable water sources and rock shelters. Also the Mbarai and Endamaghay riverine systems in the northeast would have been backed-up, flooding all the low lying areas. Although the adjacent slopes of Oldeani, Lemagrut, and Sadiman Mountains would have been important for habitation, these slopes lack rock shelters for refuge. This landscape area would have been abandoned during the wet season of the wet climate as it would have been unsuitable for forager habitation (Figure 2-4).

Inland, the Yaeda-Matala landscape area and its resources also would have been flooded during the wet season of the humid climate. The Sibiti River would have been backed-up, forming wetlands in this landscape area. It is unlikely that foragers would have utilized this landscape at all. Instead, I see the Siponga-Masiedha Hills and the Kidero Horst as the prime landscape nexuses for forager occupation under these conditions (Figure 2-4). In these two landscape areas, potable water and food resources would be available during the wet season of the wet climate. More importantly, however, the availability of rock shelters in these landscape areas would have attracted forager groups.

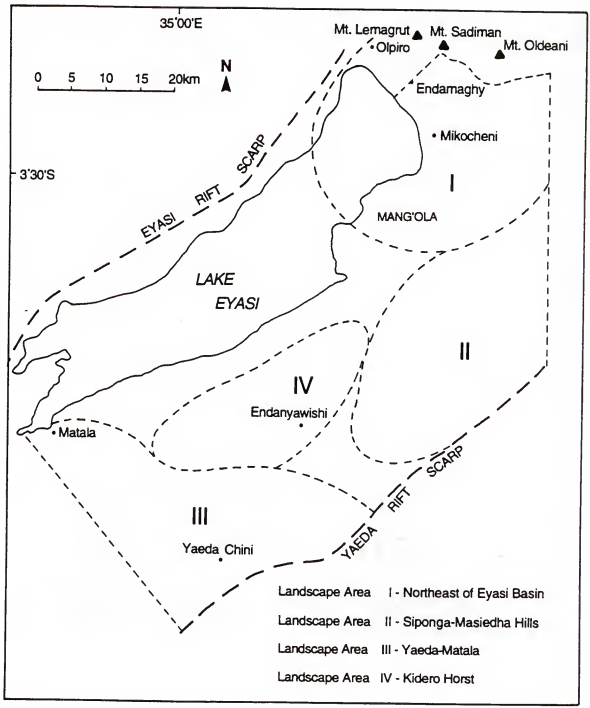


Figure 2-2: Ecologically Ranked Landscape Areas of the Eyasi Basin.

	Landscape Area I		Landscape Area II		Landscape Area III		Landscape Area IV	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Potable Water	+ +	+ + +	0 0	+ +?	0	+ +?	0 0	+?
Food — Plant	+ +?	+ + +	0 0	+ +?	0	+ +?	0 0	+ +?
Food — Animal	+ +?	+ + +	+?	+ +?	+?	+ +?	+?	+?
Rock Shelters	+ +	+	+ + +	+ + +	+ +	+ +	+ + +	+ + +
Lithic Raw-Material	+ + +	+ + +	+ + +	+ + +	+ +	+ +	+ + +	+ + +

Figure 2-3: Hypothetical Land-use System for the Dry and Wet Seasons of the Arid Climate.

	Landscape Area I		Landscape Area II		Landscape Area III		Landscape Area IV	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Potable Water	+ +	+ +	+ +?	+ +	+ +	+ +	+	+ +
Food — Plant	+ +?	+	+ +	+ + +	+ +	+	+ +?	+ +
Food — Animal	+ +?	+	+ +	+ + +	+ +	+	+ +?	+ +
Rock Shelters	+	+?	+ + +	+ + +	+ +	+ +	+ + +	+ + +
Lithic Raw-Material	+ +	+ +?	+ + +	+ + +	+ +	+ +?	+ + +	+ + +

Figure 2-4: Hypothetical Land-use System for the Dry and Wet Seasons of the Humid Climate.

Archaeological Implications of the Model

As previously discussed, the signatures of forager land-use are the material remains of their activities. These would include lithic artifacts, food refuse (e.g., animal

bones), objects of personal adornment (e.g., beads), human burials, and paintings (Ambrose and Lorenz 1990; Brandt 1988). These artifactual signatures would be concentrated in rock shelters and open air habitation areas.

As the model predicts, Landscape Area I would have multiple occupations as it is possibly abandoned completely only once, during the wet season of the humid climate. This multiple use of Landscape Area I would result in deeply stratified archaeological deposits and high density artifact scatters.

The few available rock shelters in Landscape Area I would have been the sediment traps receiving the greatest number of MSA and LSA forager artifacts, diet debris, and human skeletal remains (burials?). Purposeful burial of the dead should occur (Brandt 1988). Many of the occupied shelters would have been painted. Since foragers would have been concentrated in the northeast, dry season open air habitation areas also would have been re-occupied. This would have formed deep stratified archaeological deposits and high density artifact scatters on the surface (assuming constant n- and c- transforms, Schiffer 1995). Landscape Area I would contain a high diversity of faunal resources including those adapted to dry and wet habitats. The floral resource diversity, however, would be low.

Also, rock shelters would have been the sediment traps for forager artifacts and diet debris, in addition to preserved locations for burials and paintings in Landscape

Areas II and IV. These rock shelters, however, would not be as deeply stratified or contain as many human burials as compared to those in Landscape Area I. This is because in Landscape Area II and IV there would have been many rock shelters to choose from for habitation. Foragers would have dispersed into small groups that occupied the many available rock shelters. The occupied open air habitation areas would have even low to isolated artifact densities as they would not have been good refuge during the wet seasons. Faunal resource diversity would be moderately high. Floral resource diversity would be higher than in Landscape Area I.

In the Yaeda-Matala area (Landscape Area III), the rock shelters in the Yaeda Rift Scarps would have been the sediment traps for forager artifacts and diet refuse, in addition to locations for painting and human burial during the wet season of the arid climate and the dry season of the humid climate. Habitation of open air areas would have been limited by the marshy conditions of this landscape area. Since this landscape area would have been abandoned during the wet season of the humid climate, the archaeological deposits in rock shelters would be thin and the artifacts at open habitation areas would be isolated scatters. Faunal resource diversity would be low.

Summary

The research assumptions that I use to investigate the threshold or more likely thresholds that distinguish MSA from

LSA is cultural ecology and spatial approach. As shown in Chapter 5, I articulate this ecological and spatial approach with middle-range type of research *sensu* Binford (1977). This research strategy gives a precise and rigorous approach to understanding the ways human adaptive systems work. It offers a broad or holistic approach to the investigations of MSA and LSA foraging behaviors through the methodology of landscape archaeology. If archaeology's aim is to reconstruct the organization of human activities resulting from the relationships between humans and their physical worlds, the ecological-spatial approach advocated in this chapter is appropriate for such investigations. This approach challenges archaeologists to identify the distribution of prehistoric human activities and their spatial correlates (e. g., ecological, geomorphic, economic, cultural, etc.) across the landscape. Furthermore, it involves conscious selection of broader scales of data observation, collection and analysis, scales that are optimal for understanding foragers' adaptive behaviors. It also offers a holistic view that places individual and group behavioral patterns at the center of research, and the archaeological record is considered to reflect such structured behavioral patterns.

CHAPTER 3
RESEARCH TRENDS: MIDDLE AND LATER STONE AGE ARCHAEOLOGY OF EAST AFRICA

Introduction

As African archaeology has matured, scholars have looked backwards towards its roots and forward to its future (Musonda 1990; Robertshaw 1990a; Shaw 1989). In this chapter I summarize and assess previous Middle and Later Stone Age (MSA and LSA) research trends in East Africa. I also examine the roots of archaeology in East Africa and highlight the key themes that have united previous research efforts. My purpose is to understand the events and historical processes that have contributed to the existing MSA and LSA record in East Africa, and to provide a review of the key features of this record. An examination and assessment of previous research and the existing record will show the need for new research trends on the MSA and LSA in East Africa. In addition, one will be able to evaluate the contribution of this dissertation in enriching the presently meager state of knowledge about the MSA and LSA foragers of East Africa.

Two primary chronological stages emerge in the sequence of research. First, the "Pioneer Period" refers to the period between 1900 and 1950. The second stage alludes to the period from the late 1960s to the present, the "Post-

Pioneer Period." Although this temporal division may at first appear arbitrary, it is separated by a distinct period of time characterized by a lack of interest and research on the MSA and LSA in East Africa. As will be shown later, under the heading "Lack of MSA and LSA Research", the MSA and LSA were long neglected backwater stages in the archaeology of East Africa. Each of the two chronological stages possesses recognizable characteristics, outlined below, and generally follows the same archaeological trends observed in other parts of the continent. However, before considering past research and the existing MSA and LSA forager record, it is first necessary to define the geographical area covered in this chapter.

East Africa: A Regional Definition

One of my first tasks in this chapter is to define the area of discussion and to justify its coherence in terms of present topography, environment, climate, cultural patterns, and relationships. As a geographic unit, I define East Africa as that part of the African continent that lies between the latitudes of c. 5° N and 12° S. It is bordered on the east by the Indian Ocean and on the west by Lakes Tanganyika, Edward, Nyasa, and Albert, and the Ruwenzori Mountains. As a political entity, East Africa includes the three countries of Tanzania, Kenya, and Uganda, covering a total area of about 1.8 million km^2.

East Africa boasts impressive environmental, climatic, and cultural diversity, harboring an array of biomes of flora, avian, and fauna. A rich variety of geomorphic features--lake basins, rift valleys, fault scarps, plateaus and volcanic mountains--document the evolution of the modern landscape. Accordingly, East Africa provides the context for hominid origins and subsequent biocultural evolution, along with many other flora and fauna life forms. In the following sections I provide a summary of the cultural patterns, geology, present environments, climates, and fauna of East Africa.

Cultural Patterns and Relationships

Although East Africa has a diverse array of peoples, their cultural interrelationships transcend the ethnic identities and linguistic affiliations that existed during any period of history. Throughout prehistoric and historic times, East African peoples have not only lived in defined territories and interacted with one another, they have, of necessity, devised social forms and cultural products to meet their basic needs for food, security, shelter, reproduction mates, and language. Carrying out this undertaking within the same geographic region led to cross-cultural commonalities among the peoples of East Africa today.

Unfortunately, researchers have given little effort to search for and understand the cultural connections among East African societies. Indeed, in the archaeology of East

Africa, the nature of the interactions between cultures has received little archaeological attention, partly because of the focus on questions of culture-history rather than "processes" and cultural interactions. This approach has put more emphasis on "cultural variability" as observed at single sites that are disconnected in time, space, or both. Nevertheless, large segments of East Africa shared complex cultural traditions in terms of artifact forms (e.g., Acheulian Culture) during prehistoric times. Moreover, evidence for possible cultural interactions based upon source characterization of obsidian raw material during the MSA and LSA has been documented (Merrick and Brown 1984). Obsidian is found in the volcanic regions of Kenya. The utilization of this source material by prehistoric people in different parts of East Africa provides evidence for long-distance (of up to 200 km from the Eyasi Basin, northern Tanzania) movements and human interactions.

Other examples of cultural interactions during prehistoric times include similar suites of rock art styles during the LSA, ceramic decorations during Pastoral Neolithic (PN) and Iron Age (IA) times. Early Iron Age (EIA) ceramics known as "Urewe" Ware have been found in various parts of East Africa (see review by Stewart 1993). Other EIA ceramics of widespread distributions include "Kwale" Ware and "Triangular Incised" Ware (TIW, also variously known as "Pare Group C", "Wenje" Ware, and "Tana" Tradition [see Chami 1994; Schmidt et al. 1992 and references therein]).

Archaeologists working in East Africa have not come to grips with the meaning of such widespread stylistic and technological similarities. Nevertheless, the distributional significance of these findings extends beyond culture interactions and shared traditions; they may indicate spheres of shared ideologies as well. It is inconceivable that such stylistic and technological similarities in material culture were produced in isolation from the general fabric of East African prehistoric societies. This conclusion is risky as it may imply (to the contrary) that there was no cultural variability in East Africa. Cultural variability exists in the archaeological and historical records of East Africa. The explanations for this are many and varied including: level of technology and personal skill of the artisan; raw material type and availability, acquisition, and selection; tool use and discard; distinct needs, aesthetic demands of the ethnic group; and classificatory biases of researchers. Cultural variability, in my opinion, does not necessarily mean *lack* of contacts and interactions. Hadzabe foragers, for example, have been in contact with farmers for centuries if not millennia and continue to interact with them, yet, they continue to practice a foraging system (Chapter 5).

Geomorphology and Geology

In terms of topography, East Africa is composed of a low relief coastal plain and a broad inland plateau. The coastal plain is narrow, about 15-70 km in width. Most of the land

lies below 200 m, but some scattered hills (e.g., Pugu hills in Tanzania) and plateaus rise considerably higher. The western and eastern branches of the East African Rift Valley (EARV) slash through the inland plateau. These branches contain deep and shallow lakes, along with dry basins. Volcanic mountains and fault scarps flank the two branches of the rift valley. The western branch separates East Africa from the Congo Basin and the eastern branch divides the inland plateau into eastern and western parts. The western portion is very extensive including the central plateau of Tanzania and the Lake Victoria Basin. The eastern part of the inland plateau is narrow and includes many of the volcanic mountains.

The oldest rock of East Africa is the Precambrian sedimentary rocks, often collectively known as the Basement Complex System (Butzer and Cooke 1982). Encompassing granitic rocks, gneisses, and schists, this complex covers a large part of the region. Marine Jurassic beds occur along the coast of East Africa (Butzer and Cooke 1982). Tertiary to Quaternary volcanic rocks are found in the inland plateau of East Africa.

Climates

Located in the equatorial belt, the temperatures of East Africa are a function of elevations. Thus, highlands and plateaus are generally cooler than low-lying basins and coastal plains where mean annual temperatures can reach 26°

C. In spite of variations caused by latitude, distance from the coast, and topography, a large part of East Africa receives little annual rainfall, ranging from < 254 mm to > 1270 mm (Hamilton 1982). This shortfall produces a water deficit in many areas of the region. Morgan (1973 cited in Hamilton 1982) estimates that only c. 3% of the land surface of East Africa regularly receives annual rainfall more than potential evapotranspiration . Most rain falls between November and June, during the Atlantic "monsoon" that crosses the Congo basin and the SE monsoon that passes over the SE Indian Ocean. Consequently, the western portions of the plateau, Lake Victoria basin and the Tanzania and south Kenya coasts receive much more rainfall than other locations (Coetzee and Bakker 1989).

Present Environments

The present environments of tropical East Africa are of considerable anthropological interest. These dry woodland/bush/grassland habitats may have been the milieu in which anatomically-modern humans and their culture evolved during Middle and Late Pleistocene times (Foley 1989). The present vegetation pattern of East Africa is the result of three major factors: 1) environmental changes during the middle and late Pleistocene; 2) a reflection of the modern rainfall distribution; and 3) increased human impact on the environment from prehistoric to the present times (Coetzee and Bakker 1989; Hamilton et al. 1989; Mäckel et al. 1989;

White 1983). Laseski (1989 citing Livingstone and van der Hammen) points out that the correspondence between modern vegetation and modern rainfall patterns in East Africa have existed since the beginning of the Pleistocene.

On the basis of the distribution of species composition, White (1983) places the current East African vegetation within five units. The Somalia-Maasai region includes most of Kenya, between the highland and coastal belts and the dry lowlands of north and central Tanzania. Low and unreliable rainfall (850-500 mm) and high temperatures (between 25° and 30° C) characterize this vegetation unit. The Somalia-Maasai region is occupied by deciduous bushland and steppe, including frequent *Brachystegia* and *Acacia*. The vegetation changes in a northerly direction from closed *Brachystegia isoberlinia* woodland to *Acacia commiphora* grassland and savanna, which further north (e.g., around Lake Turkana) merges into a semi-desert.

The Lake Victoria regional mosaic occupies most of Uganda and small parts of Tanzania and Kenya that surround Lake Victoria. The rainfall is sufficiently high (1500-2000 mm per annum). This unit is composed of woodlands and a forest-like savanna mosaic. The Afromontane unit includes the highest plateaus and mountains that receive > 1000 mm of annual precipitation. This unit is composed of the Ericaceous and Afroalpine belts (Hamilton 1982), along with several transitional areas including evergreen and semi-

evergreen bushlands and thickets found at the lower elevations.

The Zanzibar-Inhambane regional mosaic occupies the Tanzanian and Kenyan coast. The rainfall is mostly between 800 and 1200 mm per year and the mean annual temperature is c. 26° C. The unit is characterized by scrub forests and edaphic grasslands and smaller areas of transitional woodland, bushland, and thicket (White 1983). The Zambezian unit occupying part of central, southern, and southwest Tanzania has the richest flora. The vegetation includes forest, deciduous and evergreen woodlands, and mosaic of woodland and grassland (White 1983).

Fauna Ecology

There has been a lack of research on the zoogeography of East African fauna. According to Delany and Happold (1979), East Africa belongs to the "Aethiopian" fauna zone. This fauna zone is characterized by very high numbers of species. These include small, medium, and large mammalian species, as well as avian and reptilian species. The commonest mammals are the ungulates, and concurrently large carnivores, including the big cats and scavengers. These are found in savanna environments. Primates such as chimpanzee and monkeys are found in the lowland forests. Gorillas dwell in the equatorial forests of East Africa.

The large mammal species include the elephant, buffalo, giraffe, zebra and rhinoceros. Medium mammal specie includes

wildebeest, eland, impala, oryx, topi, primates, warthog, Grant's and Thomson's gazelles, springbok and others. Smaller animals are represented by Kirk's dik-dik, and rock hyrax. Large cats include the lion, leopard, and cheetah. Larger bird species are ostrich, vulture, eagle, kori bustard, secretary birds. Some faunal species are migratory; many are found in more than one vegetation community. During Middle and Late Pleistocene times a greater species diversity existed, several of these species becoming extinct during the Late Pleistocene (Butzer and Cooke 1982).

Previous MSA and LSA Research Strategies

In East Africa, archaeology is a young discipline. Similarly, the history of scientific MSA and LSA research is also immature, having its beginning within the past eight decades. Before then, archaeological sites were discovered and reported anecdotally by early travelers, colonial administrators, explorers, and foreign enthusiasts during unrelated works and travels. Nevertheless, MSA and LSA research has left some historical marks that will be identified in the following sections, not only to evaluate progress so far, but also as points of departure to evaluate this work and to anticipate a future. In summarizing the history of MSA and LSA research in East Africa, Clark (1988), Merrick (1975), and Robertshaw (1990b) form the point of departure.

The "Pioneer Period" (1920s-1950s)

Among the more important pioneer works on the MSA and LSA archaeology of East Africa, those of L. S. B. and M. D. Leakey, E. J. Wayland, T. P. O'Brien, and Ludwig and Margit Kohl-Larsen deserve mention. Faced with such a vast, yet archaeologically unknown area along with a dearth of personnel, sites were investigated as they were encountered or reported by interested non-archaeologists (colonial officials, missionaries, etc.). No pre-conceived scheme or logic guided these investigations; indeed, the need for such forethought was not recognized. Three major trends or themes dominated research during the pioneer period: 1) chronology; 2) culture-history; and 3) explanations for culture change.

Chronology. From the beginning of the last century to the present, East African sediments have been a subject of studies aimed at establishing the order of biological, cultural, and geomorphic events. As such, the establishment of East African prehistoric chronology was given the highest priority during the pioneer period. E. J. Wayland is often remembered as an instrumental figure in this endeavor before the advent of chronometric dating techniques. As early as the 1920s, he correlated the Quaternary geology and lithic industries of Uganda with the climatic changes revealed by a sequence of pluvial/interpluvial episodes in lacustrine sediments (Clark 1988; Robertshaw 1990b). These episodes were then correlated with the European glacial sequences

(Alimen 1957; Robertshaw 1990b). The pluvial/interpluvial theory assumed a direct correlation between dry and cold periods or glacials of the Northern Hemisphere (NH) and wet and warm periods or Pluvials in Africa. Wayland's major concern was to provide the necessary temporal framework for establishing the contemporaneity of the lithic industries (Robertshaw 1990b), without which most issues of biological, social, and cultural significance cannot be addressed.

Other pioneers of the pluvial/interpluvial prehistoric chronology include L. S. B. Leakey, T. P. O'Brien, J. D. Solomon, E. Nillson, and H. Reck (see Alimen 1957). During the pioneer period, the pluvial/interpluvial chronological framework was widely accepted; it was even regarded as "classical" for the African continent at the Nairobi Pan-African Congress for Prehistory in 1947 (Alimen 1957). At the same conference, however, several geologists noted some flaws in its general applicability, pointing out that the climatic chronology of East Africa was marked by local and regional, as well as broader tectonic, volcanic, and climatic events (Alimen 1957). Despite these warnings, the climatic chronological framework continued to dominate East African archaeological research and writing for more than thirty years, only to collapse in the 1950s (Coetzee and Bakker 1989) as it became apparent that the presuppositions of the pluvial theory were altogether too simplistic. The increased ice of glacial periods of the NH significantly altered atmospheric patterns in a complex manner. Moreover, changes

in regional climates (e.g., East Africa) could not be directly correlated (Butzer and Cooke 1982; Coetzee and Bakker 1989). Although the pluvial/interpluvial chronological framework is now regarded as predicated on many false premises, it did lay the foundation for scientific studies of past climates in Africa.

Culture-history. Establishing the culture-history of East African MSA and LSA has been one of the major goals since the pioneer period. True to the theoretical orientation of the times, the pioneers followed the European tradition of defining cultures on the basis of types and characteristic artifacts, that is, *fossile directur*. This approach identified prehistoric cultural entities on the basis of purported "typical" artifacts and assemblages drawn from a site (Robertshaw 1990b). "Typical" sites were believed to be approximately replicated in their entirety in nearby sites in the contiguous geographical region. Furthermore, these cultures were named after entities that had already been defined in Europe and other parts of the African continent.

As noted earlier, a lack of preconceived research agendas characterized the pioneer period. Methodologically, the period was haunted by a general lack of rigor in data recovery, collection, and recording. Researchers customarily disregarded large portions of the lithic assemblage once its various components (in this case shaped tools) were counted, weighed and described (see also Mehlman 1989). Only shaped

tools and other recognized artifacts were collected during excavation. Faunal remains from archaeological deposits were studied only to provide a "fossil index" to aid in establishing the chronology of lithic assemblages. Within such a conceptual framework, it was not possible to examine broader anthropological and ecological issues concerning hominid subsistence behavior, land-use patterns, social organization, and the organization of technologies.

I turn now to a summary of pioneer researchers and their contributions. L. S. B. Leakey was the first to formally define and name archaeological assemblages in East Africa (Leakey 1929, 1931). In this venture, he was followed by E. J. Wayland (Wayland 1934). Working in the Central Rift in Kenya, Leakey recognized two cultures of broadly MSA aspect, the "Kenya Mousterian" and the "Kenya Stillbay". He also identified three cultures of LSA aspect, the "Kenya Aurignacian/Kenya Capsian", the "Elmenteitan" and the "Kenya Wilton" (Leakey 1931). In 1932, Leakey excavated Nasera rock shelter (formally Apis rock) in northern Tanzania and recovered a sequence of MSA aspect, "Levalloisian," "Proto-Stillbay" and "Stillbay" industries in the lower levels, followed in order by an MSA/LSA transitional industry, "Magosian", and LSA "Wilton" and "Kenya Capsian" in the upper levels (Leakey 1936 cited in Clark 1988; Merrick 1974). Leakey never placed the East African archaeological sequence into the three stone age techno-typological schemes (ESA,

MSA, and LSA) developed by Van Riet Lowe for South Africa (Marean 1990).

Wayland's combined geological and archaeological fieldwork led him to define the "Magosian" industry in Uganda (1931 cited in Clark 1988). In the "Magosian", elements of both the "Stillbay" (MSA) and "Wilton" (LSA) were found in combination. Accordingly, the "Magosian" was described by Wayland and Burkitt (1932 cited in Clark 1988) as a transitional industry between the MSA and LSA and was seen as the best example of a Second Intermediate. Also Wayland defined the "Sangoan" as an industry composed of lithic assemblages of both the Acheulian heavy-duty toolkit and the "Stillbay" (MSA) (Alimen 1957). The "Sangoan" was assigned to the Gamblian period and was seen as a transitional industry of the First Intermediate.

Between 1932 and 1939, Ludwig Kohl-Larsen, a physician and ethnologist, conducted three anthropological expeditions in northern Tanzania. The goal of his expeditions was mainly ethnographic. Only after the serendipitous discovery of Pleistocene palaeontological and archaeological material were some prehistoric investigations added. In 1935, Ludwig and Margit Kohl-Larsen discovered hominid remains of three individuals (Eyasi I, II and III) from the surface on the northeastern edge of Lake Eyasi (Reck and Kohl-Larsen 1936; Leakey 1936 cited in Mehlman 1989). Now attributed to archaic *Homo sapiens*, these hominid remains were in direct association with other faunal remains and stone artifacts of

the "Levalloisian" tradition. In his subsequent expeditions to the Eyasi Basin, Kohl-Larsen invited geologists and archaeologists (including L. S. B. Leakey) to establish the chronology and depositional environment of the layer containing the hominid and artifact remains. In 1938, Margit Kohl-Larsen excavated Mumba rock shelter (formally Mumba-Höhle), a large shelter on the northeast shore of Lake Eyasi revealing an archaeological sequence ranging from MSA to Iron Age (Kohl-Larsen and Kohl-Larsen 1938, 1958 cited in Mehlman 1989).

Explanation for culture change. Description of prehistoric culture change was one of the three preoccupations of the pioneer period. As mentioned earlier, archaeological cultures were defined on the basis of the presence or lack of several distinctive tool types. Such a descriptive approach discerned no hominid behavioral issues other than those associated with lithic technology and typology (Robertshaw 1990b). Cultural differences were seen only in terms of new technology and tool types. Cultural diffusion through migration or invasion served as the primary explanation for culture change through time and space. Although the causes of migration were not explained, the emergence of new archaeological cultures was sometimes linked to climatic changes.

The major goal of early excavations, therefore, was to produce a culture-history based on a flawed conceptual framework. The pioneers believed that human migrations and

invasions, as well as the diffusion of ideas, could be traced to origins either outside East Africa or the continent by searching for similarities in stone tools. The classic examples of such a conceptual framework are such terms as "Levallois-Mousterian" and "Capsian" used to refer to lithic industries thought to originate in the north (presumably Egypt and Maghreb) and eventually in Europe; the "Stillbay" was believed to arise in southern Africa; and the "Sangoan" was assumed to come from the west (most likely Congo).

The tendency to look for influences from outside the region has remained marked throughout the later periods of East African prehistory as well. Fortunately, at the same time, regional differences are accentuated (Alimen 1957); previously undefined tool types, for example, were given local names such as the "Magoasian" and "Elmenteitan" cultures (see also Robertshaw 1990b). Trigger (1990) notes that the early approach to interpretation denied indigenous people their history. Data were easily manipulated to portray prehistoric cultures as, at best, only capable of change when faced with invasion/diffusion of new cultures or the necessity of adapting to climatic changes and hazards.

The reliance on untested and preconceived notions of culture change made it possible for any innovative cultural achievements evident during the MSA and LSA in East Africa to be credited to outsiders. The pioneers typically employed a "normative" explanation for culture change, equating artifactual traits with cultural entities and different

cultural entities with either different people, time spans, or different environments. No attempt was made to investigate aspects of activity sets, raw material types and availability, and other "culture-ecological" distinctive needs that could have resulted in the manufacture of different tool-kits by the same group of people at the same or different sites (also see Robertshaw 1990b). Little use was made of the wide range of techniques now available to examine the archaeological record. In keeping with the concerns of archaeology at the time, Leakey, O'Brien, Wayland, Kohl-Larsen and other pioneers attempted to standardize typologies and terminologies and poured even greater energy into achieving regional and inter-regional perspectives on MSA and LSA cultural traditions.

Neither the pioneers' explanatory framework for culture change, their correlation of culture change with climatic change, nor their lithic nomenclature (except MSA and LSA) have survived the test of time and new analytical methods and interpretative frameworks. It should be stressed, however, that the lapses noted here are not necessarily due to the failings of early investigators. Archaeology has only recently become much more concerned with observing patterns of distribution within settlements, statistical sampling, systematic data recovery and recording, subsistence behavior, lithic technology (raw selection and material procurement; tool manufacture, use and discard) and the like. It is important to note that, at the beginning of the twenty-first

century, after more than eight decades of archaeological investigations in East Africa, it is still virtually impossible to conduct research on the MSA and LSA without reference to the work of the pioneer period (Mabulla and Reid 1993). The pioneer period indeed sets the stage for modern methods and theories in the archaeology of East Africa.

Lack of Research on the MSA and early LSA

From the late 1950s to mid 1960s such pioneers as L. S. B. and M. D. Leakey shifted their interests to the study of early hominids and cultures at Olduvai Gorge and other Plio-Pleistocene sites (Clark 1988; Robertshaw 1990). Likewise, the British Institute in Eastern Africa (BIEA) focused its investigations on the mid-Holocene LSA and Iron Age to document the transition from foraging to food production (Clark 1988). The major objective of BIEA was to demonstrate that food production originated outside East Africa (see Robertshaw 1990b). Another reason for this shift was probably the view that the African MSA was younger than the Eurasian LSA/UP (see also Clark 1988). The limited number of radiocarbon dates available in Africa before the 1970s reinforced such ideas. These dates suggested that the Acheulian technocomplex continued in Africa south of the Sahara until 60,000 to 40,000 BP, the MSA dated to between 40,000 and 10,000 BP, and the LSA was post 10,000 BP (Clark 1962; Clark 1970). Moreover, associated faunal assemblages were thought to be of existing species. Researchers at the

time possessed no reliable means to date MSA and early LSA sites as the sites were too young for conventional K-Ar dating and beyond radiocarbon dating (Clark 1988).

Another reason for the lack of interest in the MSA was the apparently limited visibility of evidence for MSA hominid activities. Hominid, faunal, and other non-lithic remains of the MSA period are fragmentary and poorly preserved (Klein 1983). This circumstance contrasts with the Early and Later Stone Age periods where the hominid, faunal and other non-lithic remains are well preserved and the visibility of evidence for hominid activities is great. Although fossil remains of early *Homo sapiens* have been known from Lake Eyasi, Tanzania, and Kanjera, Kenya since the early part of the 19th century, their biocultural evolutionary examination was eclipsed by the pursuit of early hominids. MSA hominid remains were thought to be recent and, therefore, less interesting. As Clark (1988) acknowledges, there was no indication at the time that anatomically-modern humans might have evolved during the MSA. The lack of research has adversely effected the development of MSA and LSA research in East Africa.

Post-Pioneer Period (Late 1960s-Present)

The late 1960s to 1980s saw some research focusing on the MSA and LSA in East Africa. This renewal of interest can be attributed to scientific development in chronological studies in the late 1950s, 1960s, and early 1970s.

Increasing numbers of radiocarbon dates and stratigraphic studies showed that the beginning of the MSA in East Africa was older than the upper limit of radiocarbon dating. These new studies also suggested that by 35,000 BP, MSA technology had ceased (Vogel and Beaumont 1972), giving way to LSA technology. Climatic studies (e.g., oxygen-isotope analysis and palaeomagnetic stratigraphy of deep-sea cores) also showed that climatic changes during the MSA were global and synchronous both for Africa and Eurasia (Shackleton and Opdyke 1973). These studies linked the beginning of the MSA in Africa with the high interglacial sea level (oxygen-isotope stage 6e) of about 125,000 BP, based on South African sites (ibid). This realization led to renewed scientific interest in the MSA and LSA records. The fossil hominid and archaeological remains discovered during the pioneer period were consequently re-analyzed and re-interpreted in light of newly obtained chronology, new methodology, and revised theories of hominid and cultural evolutionary patterns and processes. These re-interpretations have yielded a far more dynamic picture of the African MSA and LSA.

Despite significant advances, East African archaeology has carried on two research traditions from the past (pre-1960s). First, research into culture-history, principally through excavation, typology, and chronology has remained a basic concern. This condition has been caused by research questions that focus on issues of culture "origins" and "change" (Robertshaw 1995), and because large portions of

East Africa remain archaeologically *terra incognito*. Research is often irregular and disconnected in time and space, making it more difficult to generalize without a reasonably dated culture-history. A reasonably dated cultural and historic sequence is a first step toward investigating broader anthropological and ecological issues of prehistoric foraging systems because it provides a substantial database for comparisons, generalizations, and hypotheses testing.

Second, many archaeological investigations have been carried out at sites discovered during the pioneer period. These early trends, however, have coalesced with the framework of anthropological archaeology of the 1960s and 1970s, a framework that challenged prior theory and methodology. Examination of the MSA and LSA literature clearly documents this change of approach in East Africa.

Researchers started to formulate their problems beforehand as suggested by the "New Archaeology" (e.g., Mehlman 1989; Merrick 1975; Nelson 1973). Data collection gradually began to display increasing rigor in survey strategies, excavation techniques, and data recovery and recording, including probabilistic sampling (e.g., Bower et al. 1977). In contrast to Kohl-Larsen's sample of selected tools and bones, now practically everything was considered important (e.g., Mehlman 1989). Both inorganic and organic materials are now systematically collected for chronometric dating.

More detailed, processual studies of ecological and cultural adaptations now supplement research into culture-history, typology, and chronology. Analysis of larger samples of lithic and faunal assemblages, past environments, and climates provide the basic data for these processual studies (Anthony 1978; Bower et al., 1977; Gramly 1976; M. Leakey et al. 1972; Marean 1990; McBrearty 1988; Mehlman 1989; Merrick 1975; Miller 1979). Studies tend to place less emphasis on pure description (typological studies). Investigators now usually analyze their data with an eye toward such topics as source determination of raw material procurement, tool manufacture and use, land-use, environmental reconstruction, subsistence patterns, hominid adaptations, and the like. This approach is more often integrated with studies on the transformational processes (c- and n- transforms) affecting the lithic and faunal remains as suggested by Schiffer (1995).

Arguments for population migration or invasion from outside East Africa as the agent of culture change are rejected on chronological, theoretical, and human skeletal grounds. An assessment of skeletal remains from Gamble's Cave and other LSA sites by Rightmire (1974) found no compelling evidence to associate the early LSA assemblages with a "Caucasoid" race (*contra* L. S. B. Leakey 1935). Consistent early dates for the occurrences of MSA and LSA assemblages in East Africa completely put to rest the migration theory. Instead, culture change is more often

thought to result from locally generated ideas, abilities, and capabilities, especially as these involve the technological, economic, and social innovations of cultural systems adapting to local climates and environments (Clark 1970; Cole 1963; Merrick 1975). Variations in material culture during the MSA and LSA are now explained in terms of either functional, cultural, raw material types and availability, technological levels, or ecological conditions and hypotheses (e.g., Clark 1982, 1988). Nonetheless, the appropriate characterization of either cultural style or tool function as the cause of lithic variability is still the subject of extended controversy (the Bordes vs. Binford debate, see Chapter 2). Also, the measurements of the degree of past ecology, against which we can asses cultural adaptations during the MSA and LSA, is unclear in East Africa. For example, recent findings do not support Clark's (1982, 1988) prediction that lithic variability is a function of ecology--that is, attributing the appearance of the heavy-duty assemblage of early MSA, or "Sangoan", to forest adaptations (McBrearty 1992).

Some efforts have been directed toward dating, re-analyzing, provenancing, and re-interpreting the Middle and Late Pleistocene lithic, hominid, and faunal remains discovered during the pioneer period and in recent times. The goals of these efforts have been to establish their phylogenetic, chronological, and cultural relationships (Brauer and Leakey 1986; Plummer et al. 1994; Manega 1993).

Since much research still focuses on sites discovered during the pioneer period, little exploration has been carried out into new areas. Generally, there has been a lack of systematic survey of new localities for MSA and LSA sites in East Africa, although some progress has been made in recent years. More importantly, the MSA and LSA time span has received much more attention in Tanzania. N. J. Karoma and the University of Dar es Salaam conducted surveys and test excavations in Kilwa Coast, southern Tanzania. The research recovered "Sangoan", MSA, and LSA material (N. J. Karoma, personal communication 1993). In the Serengeti plains, Bower and Gogan-Porter (1981; Bower et al. 1985) excavated MSA and LSA lithic at the Loiyangalani River site. An early MSA that is likened to the "Sangoan" was recovered from the surface eroding from the upper Ndutu Beds at Olduvai Gorge (Mabulla 1990). Additional survey and test excavation in the Late Quaternary deposits at Olduvai Gorge was undertaken by S. A. Brandt and A. Z. Mabulla in 1990. In the Rukwa Valley, south-western Tanzania, Willoughby's (1990, 1992) surveys have recovered cultural material of MSA and LSA affinities. Detailed publications of the lithic assemblages from these recent researches are eagerly awaited. In Kenya, MacBrearty (1988, 1992) has strived to establish the archaeological contexts of the "Sangoan" industry at Muguruk and Songhor.

In contrast to the site-oriented works that dominated MSA and LSA research from the pioneer period to the present,

some theoretical and methodological developments have surfaced in recent years. For example, regional surveys are now being implemented (Foley 1981; Kelly and Harris 1992; Rogers and Harris 1992; this research). Although this approach is still embryonic in East Africa, it has tremendous potential for illuminating the anthropological and ecological systems of prehistoric foragers. Of course, certain developments now evident in the archaeology of the MSA and LSA will continue through the 1990s and beyond, while others that are just taking shape will gain momentum in the coming years.

Key Features of the East African MSA and LSA Record

In this section, I summarize the current record and our understanding of biocultural evolution during the MSA and LSA by examining four dominant themes: 1) lithic techno-typological framework; 2) hominid behavior; 3) fossil hominid remains; and 4) past environments. My major concern is to identify specific advances or problems and their implications for the study of hominid behavior during the MSA and LSA in East Africa.

Lithic Techno-Typological Framework

It is very difficult to construct a broad synthesis of spatial-temporal changes in lithic techno-typology of the MSA and LSA in East Africa, despite Clark's (1988) efforts. This is because of 1) small sample sizes of artifacts; 2) few

reliably dated MSA and LSA sites; 3) systematic investigations of the organization of technology are virtually nonexistent; and 4) typological variabilities in artifacts.

The terms MSA and LSA were originally defined as culture-stratigraphic entities in the Stone Age sequence of South Africa (Goodwin and van Riet Lowe 1929). Usage of the terminology was later extended to cover all of sub-Saharan Africa. The MSA and LSA carry both cultural and chronological meanings. They connote two groups of cultures, each with similar lithic technology and tool kits. In their definition of the MSA, Goodwin and van Riet Lowe (1929) noted the importance of the Levallois and disc core methods of flaking in producing flakes with faceted platforms and a tendency to convergent rather than to parallel flaking on the dorsal surface of flakes. Scholars distinguish the MSA from the ESA by a general lack of the large bifacial tools (handaxes and cleavers) that are the *fossiles directuers* of the Acheulian and from the LSA by an absence of microliths (backed blades and geometric forms), the hallmarks of the LSA (Clark 1988). Typologically, the MSA is characterized by scrapers and points (Clark 1988). The chronological meaning of the MSA, however, is not well established, but on the basis of recent dates, an overall time span of c. >200,000 to 20,000 BP is conceivable.

Goodwin and Van Riet Lowe (1929) defined the LSA as lithic assemblages or cultures that also included nonlithic

items such as worked bone implements and ostrich eggshell beads. Techno-typologically the LSA is distinguished from the MSA by a general decrease in size of tools and the use of blade core technology. Formal tools are commonly backed and often take the morphology of geometric microliths. The available data suggest that the LSA in East Africa ranges in age from c. >40,000 to about 7,000 BP (Ambrose 1992; Manega 1993). Other characteristics associated with the LSA include: rock art production, inferred use of bow and arrows, intensification in the utilization of plant and aquatic resources, symbolism, inferred personal aesthetic, and evidence for religion. From the beginning, Goodwin and Van Riet Lowe linked the MSA with anatomically-archaic humans and the LSA with anatomically-modern humans and behavior. As Wadley (1993) correctly notes, the Goodwin and Van Riet Lowe definitions of MSA and LSA are no longer tenable. Now it is clear that worked bone implements, remains of fish and plants, and ostrich eggshell beads that were assumed to be restricted to LSA times, predate the emergence of the LSA by tens of thousands of years. Moreover, remains of anatomically-modern humans dating to c > 100,000 BP have been found in MSA deposits in eastern and southern Africa.

Despite serious reservations about the conceptual framework of the MSA and LSA entities (e.g., defined on the basis of inadequately described sites and industries in south Africa, correlation of the "Age" system with finite time-periods [Clark et al. 1966; Mehlman 1989]), nevertheless, the

terms continue to be used in East Africa. Many of the lithic industrial names (e.g., Sangoan, Fauresmith, Wilton, etc.) used during the pioneer period, however, have been dropped as they were not adequately defined, and have little or no validity now (Clark 1988). Researchers now prefer to use local names to define the chronostratigraphy and the artifact composition of identified entities (Clark 1988). This approach, however, has caused confusion and ambiguities in the nomenclature and terminology of MSA and LSA records in East Africa. For the purpose of establishing a techno-typological framework for East Africa, I divide the MSA and LSA record into 1) First Intermediate Industries; 2) "typical" MSA; 3) Second Intermediate Industries; and 4) "typical" LSA. The available data from excavated sites now seem sufficient to warrant recognition of the first and second intermediate industries in East Africa (see also Mehlman 1989).

First intermediate industries (FII). This term refers to "transitional" lithic assemblages that combine both elements of the Acheulian techno-complex and "typical" MSA. The term was abandoned following the Burg Wartenstein recommendations in 1965 because it was realized that the so-called "transitional" industries were poorly defined from surface findings that were often mixed. Lithic assemblages that showed both features of the Acheulian techno-complex and "typical" MSA were then lumped into either late Acheulian or early MSA.

Typologically, the FII in East Africa combines a late Acheulian heavy-duty toolkit (particularly small bifaces, core axes, core choppers, and core scrapers) and "typical" MSA features, *i.e.*, prepared cores (both disc and Levallois) and small tools (mainly scrapers) on flakes. This lithic assemblage is variously known as the "Sangoan" or "Njarasan" Industry. The name "Sangoan" comes from the type site of Sango Bay in Uganda and "Njarasan" comes from the Sukuma word ("nyaraja") for the Lake Eyasi's salt. The precise nature of the "Sangoan" or "Njarasan" industry (e.g., its age, environmental contexts, faunal remains, associated hominid fossils, etc.) has been problematic since its description (Wayland and Smith 1923). This condition resulted because of a lack of excavated samples from reliable stratigraphic contexts. Nevertheless, this situation has changed in recent years as *in situ* "Sangoan" materials have been excavated. Now it is clear that "Sangoan" implements overlie Achaeulian artifacts (e.g., at Kalambo Falls) and underlie those of the "typical" MSA (e.g., at Muguruk) at multicomponent sites such as Muguruk, Simbi, and Kalambo Falls (McBrearty 1988, 1992). Although some researchers (e.g., Clark 1988) consider the "Sangoan" as early MSA, it has never been found interstratified with MSA assemblages (McBrearty 1992). Thus, the "Sangoan" occupies a position intermediate between the ESA and the MSA.

In East Africa, occurrences of "Sangoan" artifacts have been found in areas that presently have closed vegetation

patterns such as around lakes, rivers, and highlands. These include the Eyasi Basin, Olduvai Gorge (upper Ndutu Beds), Laetoli (upper Ngaloba Beds), Kilwa coast, Kagera River basin, Nyara River basin, Tendaguru, Isimila, and others in Tanzania; Muguruk, Malewa Gorge, Kinangop, Simbi, and Prospect Farm in Kenya; Nsongezi, Sango Hills, Galula, and Kabinda in Uganda (Clark et al. 1970; Mabulla 1990; Mehlman 1989). Based on this association, Clark (1982, 1988) argued that the "Sangoan" toolkit was a forest adaptation, possibly used for woodworking. Recent research by McBrearty (1992) shows that the makers of the "Sangoan" at Simbi were adapted to a grasslands habitat. This conclusion was reached on the basis of the associated faunal remains (large equids), plant macrofossils, as well as isotopic analyses of plaeosol carbonates and organics. McBreaty (1992) concluded that "Sangoan" technology may be seen as an adaptation to a habitat not unlike that known for earlier East African Plio-Pleistocene sites. This conclusion is supported by data from Olduvai Gorge where "Sangoan" or "Njarasan" artifacts have been found eroding from the upper Ndutu Beds (Leakey et al. 1972; Mabulla 1990). Recent studies show that the Ndutu Beds were deposited during a period of increasing aridity at Olduvai Gorge (Hay 1976; Cerling and Hay 1986; Manega 1993).

On the basis of either extinct fauna, stratigraphy, or past climates, "Sangoan" assemblages are often c. > 200,000 BP or oxygen-isotope stage 6 (Mehlman 1987, 1989). Chronometric dates for the "Sangoan," however, are very few.

Conventional K-Ar dates of c. 400,000 and 220,000 BP were obtained for the "Sangoan" assemblages from Kinangop and Malewa (Evernden and Curtis 1965 cited in Clark 1988). At Simbi, the "Sangoan" is stratified between two tuffs that have been dated to about 50,000 and 200,000 BP (McBrearty 1992). The upper Ndutu Beds at Olduvai Gorge and the upper Ngaloba Beds at Laetoli have recently been re-dated to between c. 300,000 and 200,000 BP using the SCLF $^{40}Ar/^{39}Ar$ technique (Manega 1993).

"Typical" MSA industries. This refers to lithic assemblages dominated by flake tool kits that conform to Goodwin and Van Riet Lowe's techno-typological definition. Typical MSA industries contain prepared cores, scrapers, and retouched points. Core and other large cutting tools are rare or absent. MSA assemblages are widespread in East Africa and have been found in closed as well as in open vegetation types. Moreover, the MSA in East Africa is characterized by interassemblage lithic variability. Whether this indicates the beginning of regional cultural identity (Clark 1988) or long term-ecological adaptations to specific habitats (Kelly and Harris 1992) is at present unclear. The main important sites where MSA material have been found includes: Songhor, Muguruk, Lukenya Hill, Prolonged Drift, Prospect Farm, east Turkana, and Enkapune Ya Muto in Kenya; Orichinga Valley in Uganda; and Serengeti plains (Loiyangalani River), Nasera rock shelter, Eyasi Basin (including Mumba rock shelter), Lake Rukwa Basin, Kilwa

Coast, and others in Tanzania (Bower and Gogan-Porter 1981; Bower et al. 1985; Mehlman 1989; McBrearty 1988).

Reliable dates for the MSA at the limits of radiocarbon and conventional K-Ar techniques are lacking in East Africa. Nonetheless, the MSA is assumed to span the time between 130,000 and 40,000 BP. In northern Tanzania, a uranium series date of about 130,000 BP has been obtained for the MSA (Sanzako Industry) in level VI-B at Mumba rock shelter (Mehlman 1989). The level VI-A MSA ("Kisele" Industry) that overlies the "Sanzako" Industry (early MSA) at Mumba is also found at the Nasera rock shelter from level 12 to the base of the sequence. The "Kisele" Industry is estimated to date between 90,000 and 50,000 BP (Mehlman 1989).

Second intermediate industries (SII). This refers to lithic assemblages that are transitional in nature, with a combination of MSA and LSA features. MSA/LSA transitional assemblages are composed of radial and disc cores, points, and small scrapers (MSA features), bipolar cores, backed tools, and microlith assemblages (LSA features). MSA/LSA transitional industries are few and not well documented in East Africa because of a lack of occupation after the latest MSA at many sites. A few sites such as Mumba, Nasera, and Kisese II rock shelters in Tanzania and Enkapune Ya Muto rock shelter and Lukenya hills in Kenya have yielded MSA/LSA transitional assemblages with minimal or no stratigraphic hiatus (Ambrose 1984; Inskeep 1962; Mehlman 1989; Merrick 1975).

At Mumba rock shelter the MSA/LSA transition level ("Mumba" Industry) dates to > 30,000 BP (Mehlman 1989). The MSA/LSA transition level ("Naseran" Industry) at Nasera rock shelter date to about 25,599 (uraniums series) BP (Mehlman 1989). At Mumba rock shelter, the "Nasera" Industry is dated to 26,960 BP (radiocarbon date on ostrich eggshell). The MSA/LSA transition level at Kisese II in central Tanzania was dated in the 1960s. A date of 31,480 BP was obtained on charred ostrich eggshell (Deacon 1966). It is possible that the transitional industries at these sites may be older than the effective limit of radiocarbon dating (Mehlman 1989). Radiocarbon and temperature-calibrated obsidian hydration dates from Enkapune Ya Muto suggest that the MSA/LSA transition occurred well before 46,000 BP (Ambrose 1992).

"Typical" LSA industries. This refers to lithic assemblages that conform to Goodwin and Van Riet Lowe's definition. Like the MSA, the LSA of East Africa is characterized by temporal and spatial variabilities in the lithic assemblages. Overall, there are many more LSA sites known in East Africa than there are MSA sites. This may indicate that LSA foragers were either more widespread or had a larger population density than MSA. Likewise, it may reflect the intensity of research on the LSA as well as good archaeological visibility.

Dating LSA assemblages is extremely difficult in East Africa as many of the dates are either obtained from unreliable dating material or unreliable dating techniques.

At Nasera rock shelter, a radiocarbon date on bone of 21,000 BP has been obtained for the LSA ("Lemuta" Industry) levels (Mehlman 1989). Kisese II has provided a date of 18,190 BP on charred ostrich eggshell for the LSA levels (Deacon 1966). Many of the chronometric dates for the LSA in East Africa are based on intrinsically less reliable materials such as bone apatite, and are rejected along with more reliable ones on bone collagen (Collett and Robertshaw 1983). Perhaps the best dating evidence for the LSA comes from Olduvai Gorge in Tanzania. Recently, a SCLF $^{40}Ar/^{39}Ar$ age of > 40,000 BP has been obtained for the Naisiusiu LSA site at Olduvai Gorge (Manega 1993). Previously, the Naisiusiu LSA site was dated to 17,000 BP (Leakey et al. 1972). The age of > 40,000 BP may make the Naisiusiu LSA assemblage one of the earliest LSA assemblages known in East Africa.

Hominid Behavior

In this section, I will summarize and evaluate MSA and LSA forager behaviors as reflected by subsistence, land-use or settlement patterns, symbolism, and the organization of lithic technology.

Subsistence. The subject of hominid subsistence appears in almost every site report, although to varying degrees. Nonetheless, information on hominid subsistence behavior in East Africa is inadequate, leading to a lack of a thorough characterization about fauna and flora exploitation strategies by MSA and LSA foragers. In part, this deficiency

is attributable to the scarcity of relevant evidence in the field. Most of the MSA and LSA sites of East Africa are open-air sites, characterized by poor preservation of organic materials. In particular, faunal assemblages from excavated MSA and LSA sites generally range from nonexist to meager (Anthony 1978; McBrearty 1988; Mehlman 1989). Moreover, the results of surface investigations of MSA and LSA sites do not provide grounds for optimism about faunal recovery from yet unexcavated sites (Bower et al. 1977). Needless to say, very few MSA and LSA faunal assemblages have been reported and analyzed in a systematic fashion (Marean 1990). These handicaps, together with a lack of "living floors" to reveal social-behavioral activities, have created major difficulties in inferring the subsistence economy of MSA and LSA foragers in East Africa.

At present, faunal assemblages indicate that MSA and LSA foragers exploited small, medium, and large mammalian species of different habitat preferences (Marean 1990; Mehlman 1989). No one faunal assemblage in East Africa, however, offers clear evidence of hominid hunting behavior comparable to MSA and LSA human behavior as seen in southern Africa. Neither has it been possible to infer other aspects of hunting behavior, such as prey specialization and carcass processing. MSA and LSA faunal assemblages have likewise thwarted taphonomic investigations of site formation processes and past environments (Marean 1990). Nonetheless, Clark (1988) speculates that the frequent occurrence of haftable points in

MSA lithic assemblages might indicate an increase in hunting efficiency. This suggestion seems plausible, yet it remains unsubstantiated.

Evidence from Mumba rock shelter in the Eyasi Basin shows the exploitation of land snails (*Burtoa nilotica*) by the terminal MSA, the earliest known evidence for the exploitation of this resource (Mehlman 1989). At site GvJm46, Lukenya Hill, Marean (1990) observed no differences between MSA and LSA foragers in terms of subsistence behavior. The MSA and LSA horizons at GvJm46 are separated in time, yet both horizons are dominated by the small alcelaphine. Moreover, the body part patterns and the cut mark frequencies are the same. This is interpreted to suggest continuity in forager subsistence behavior between the MSA and LSA regardless of the temporal differences (Marean 1990). No studies of other food resources (e.g., plant foods, honey, etc.) have been carried out for East Africa. These resources, which constitute primary components of modern forager diets, remain archaeologically invisible (Clark 1988).

Land-use or settlement patterns. Settlement or land-use patterns are poorly understood. The geographical distribution of MSA and LSA foragers is inadequately understood and few distribution studies have been done. This weakness reflects past research orientations that focused primarily on single sites. Moreover, the lack of large-scale excavations has meant that we cannot discern and identify

hominid socio- and eco-spatial patterning during the MSA and LSA. If we really want to understand hominid adaptive behavior, we must study their use of space and its patterns. This approach focuses on the repetitiveness of behavior across the landscape and hominid generations, not on the way hominids organized their space at a single site and specific time (see Chapter 4). It is clear that such studies are not common for the MSA and LSA in East Africa. This condition has begun to change, however (Foley 1981; Kelly and Harris 1993; Rogers and Harris 1992; this study).

Symbolic behavior. Evidence for symbolic behavior (e.g., the production of art, burial practices, ornamental objects, etc.) is missing for the MSA of East Africa, possibly due to taphonomic biases. Pigment, usually hematite has, however, been found at several MSA sites. Clark (1988) hypothesizes that this pigment was used for personal adornment and possibly for decorating tools and equipment (Clark 1988). Clark's hypothesis is difficult to test as body and tool ornamentations are unlikely to be detected by archaeology. The specific application of pigments during the MSA in East Africa is, therefore, still unknown. In addition, there is no clear evidence for rock art, human burials, or objects of personal adornment in East Africa during the MSA. In contrast, expressions of symbolic behavior such as human burials, rock art, and objects of personal ornamentation (e.g., ostrich eggshell beads) are widely found in LSA contexts.

Organization of lithic technology. To understand an artifact requires taking account of production techniques, material properties, and patterns of use and discard. Although investigations dealing with an understanding of lithic artifacts have been a major aspect of African Stone Age research for a long time, systematic investigations of the organization of technology in the East African MSA and LSA are virtually nonexistent. Consequently, MSA and LSA technologies and the uses and discard of produced MSA and LSA implements are minimally understood in East Africa. Lithic sources, however, have not been entirely ignored. A few scholars have matched artifacts with raw materials and analyzed how the exploitation of quarries interfaced with hominid mobility, land-use, and subsistence patterns (Barut 1994; Merrick and Brown 1984). Studies on the organization of lithic technology can enable archaeologists to explore anthropological and ecological issues such as hominid planning, expressions of conscious choice, anticipation, and transport behavior during the MSA and LSA.

Past Environments: A Context for *Homo sapiens* Evolution?

The environment is inevitably linked in a relationship with people and their material culture. According to this view, a product of culture (e.g., artifact form, use, discard, etc.,) or biology (e.g., evolution of a new species) can also be observed and measured on an environmental scale.

In this sense, the environment of the cultural or biological event is as important as the artifact or new species.

Over the last three decades palaeoclimatic studies have unraveled evidence of global environmental and climatic changes in the past. Although the cause(s) of such widespread environmental and climatic changes are contested, most researchers attribute the shifts to orbital forcing (Bradley 1985; Imbrie et al., 1989). Some researchers argue that such environmental changes, possibly associated with global climatic changes, were the initiating cause of hominid biocultural evolutionary events in Africa (Vrba 1989 and references therein).

The Middle and Upper Pleistocene, a period spanning the interval from 500,000 to 75,000 (Oxygen Isotope Stages 12-5a) BP, also experienced significant changes in climate and environment culminating in the present climate and environments in East Africa. Sedimentary evidence suggests possible significant environmental fluctuation in the marine and continental areas of East Africa. Unfortunately, an accurate reconstructions of the environments during the Middle and Upper Pleistocene is often impeded by unsatisfactory time control (e.g., Trauth and Strecker in press). With the exception of Olduvai Gorge and Mount Kilimanjaro, no reliable bracketing of radiometric dates has been obtained for the climatic and environmental changes during the middle and late Pleistocene eras. Moreover, rigorous, detailed investigations of events have not been

attempted; most researchers have concentrated on either the Lower Pleistocene or the last 30,000 BP. Little is known about the Middle and early Upper Pleistocene of East Africa, despite some recent progress.

Traces of glaciations during the Middle and early Late Pleistocene have long been evident on the highest mountains of East Africa (for a recent review, see Rosqvist 1990). Age estimates for these ancient morainic deposits have been primarily inferred from relative dating methods. Evidence of three Middle and early Late Pleistocene glacials have been recorded on Mount Kilimanjaro. On the basis of K-Ar dates of the Kilimanjaro lava, the first and second glaciations occurred around 500,000 and 300,000 BP (Humphries 1972, cited in Rosqvist 1990). The age of the third glaciation, inferred from relative weathering characteristics and from its position, is thought to have occurred between 150,000 and 120,000 BP (Humphries 1972 cited in Rosqvist 1990). Evidence of early glaciation on Mount Kenya has been found on the eastern and western flanks of the mountain (Mahaney 1989). Absolute age determination for the early glaciation (pre-Teleki tills) is inconclusive, although a thermoluminescence age determination of 100,000 BP has been obtained for the Teleki tills (as cited in Charsley 1989).

In unglaciated environments of East Africa, climatic changes are recorded in ocean, terrestrial, and lacustrine sediments. Both biologic and lithologic data from these sediments can be used to infer past climates and

environments. The study of the stable isotope composition of soil carbonate at Olduvai Gorge by Cerling and Hay (1986) indicates that the Masek Beds underlying the Ndutu Beds were deposited during a period of hot and dry conditions similar to the present day. Cerling and Hay inferred from ∂O18 and ∂C13 of the soil carbonate that the mean temperature during the deposition of the Masek Beds at c. 850,000 BP was 15° and 18° C (Manega 1993). Since then, temperatures have increased to modern mean annual temperatures of about 23° C (Hay 1976). Temperature estimates from ostrich eggshell amino acids by Manega (1993) yielded pre-Holocene values 6-8° C lower than the current mean annual temperature of 23° C at Olduvai Gorge. The appearance of the land snail of the genus *Limicolaria* in the Masek Beds and throughout the Ndutu Beds also points to increased aridity (Hay 1976).

Van Campo et al (1990) have combined oxygen isotope, planktonic foraminifera and pollen record from core MD79-254 obtained off the Mozambique coast to estimate land and sea surface mean temperatures over the past 135,000 BP. All the standard isotope stages and substages were identified to stage 8 and used to apply the time scale derived by Imbrie et al (1984, cited in Van Campo et al 1990) to estimate the age of each level. The combined oxygen isotope, planktonic foraminifera and pollen record show that at 135,000 BP the sea surface temperatures (SSTs) were cool, averaging 24.1° C. Warm SSTs similar to today (26° C) occurred during the

interglacial phase estimated at 120,000 BP (Van Campo et al 1990).

Lacustrine sediments have been the focus of recent attempts to understand palaeoenvironmental changes during the Middle and early Upper Pleistocene of East Africa (e.g., Hillaire-Marcel et al 1986; Somi 1993; Trauth and Strecker forthcoming). Hillaire-Marcel et al (1986) studied the isotopic compositions of stromatolites from the sediments of Lake Natron-Magadi basins. They show that the Lake Natron-Magadi basins have three generations of stromatolites: the first and oldest dated to c. 240,000 BP (Oxygen Isotope Stages 8-7), the second dated to about 135,000 BP (the last interglacial), and the third to about 108,000 BP. These Th/U-chronologies indicate three major phases of maximum lake levels in the basins.

Somi (1993) recorded four separate palaeolake stages at the Lake Manyara basin, two of which are relevant for this review. Lake Manyara's palaeolake I stage, standing at 1036 meters above sea level, is the oldest lake-level highstand recorded by Somi. This palaeolake is characterized by negative values both of $\partial C13$ and $\partial O18$. The age of this ancient Lake Manyara level is assigned to 130-140,000 BP (Somi 1993). During this time, the lake was "fresh", covering an area of 1,976 km^2 and contained a water volume of about 169.2 km^2. According to Somi, Lake Manyara palaeolake I had a level controlling outlet to the north into the Natron-Magadi basins. This shore line may correlate with

Lake Natron-Magadi's second generations of stromatolites (or high stand palaeolake level) dated at c. 135,000 BP (Casanova and Hillaire-Marcel 1992; Somi 1993). Lake Manyara's palaeolake II is inferred to be > 90,000 but < 135,000 BP. These humid events of Lake Manyara are also discerned at Lake Eyasi located about 80 km west (Chapter 5). Periods of interchanging moderate wet and dry conditions characterized the Eyasi basin during Middle to early Late Pleistocene (Mehlman 1989). Unfortunately, the study of past environments in the Eyasi basin is beset with lack of detailed geological, chronological, and palaeoecological studies by experts in these fields.

Lake-level highstands have also been recorded in the Lake Naivasha basin (Trauth and Strecker forthcoming). These lake-level highstands are found in lacustrine sediments believed to date between 400,000 and 200,000 BP (Trauth and Strecker forthcoming). No precise age information exists for Lake Naivasha's Middle and early Upper Pleistocene lake levels. Nevertheless, the fact that present lakes once stood at higher levels provides evidence that East Africa was wet and humid during some parts of the Middle and early Late Pleistocene.

Whereas the sequence of palaeoclimatic events is becoming clearer in East Africa for the very late Upper Pleistocene and Holocene (Hillaire et al. 1986; Roberts et al. 1993), this is not the case for the Middle and early Upper Pleistocene. The timing, magnitude, and extent of

these events are, at present, unclear, possibly because of lack of detailed research and chronological control. Nevertheless, some tentative conclusions can be drawn. The available glacial and SST evidence indicates cool temperatures. The lowering in temperature must have affected the vegetation of the high mountains as plants could not have survived under harsh conditions. Lithologic and biologic evidence from terrestrial sediments consistently point to dry conditions at Olduvai Gorge. This progression to aridity must have completely changed the vegetation pattern of East Africa. Arid and semi-arid types of vegetation must have spread at the expense of woodlands, which in turn probably gave way to dry grasslands. This dry period, however, was interspersed with humid conditions as indicated by highstand palaeolake-levels. Although the degree of rainfall increase has not been determined, the available evidence indicates higher rainfall than today.

Available data from East Africa show three short phases of humid conditions: first, at c. 240,000 BP (Oxygen Isotope Stages 8-7); second, at about 135,000 BP (the last interglacial); and third, at about 90,000 BP. The palaeoclimates of East Africa during the Middle and early Upper Pleistocene appear, therefore, to have been dominated by an interplay of synoptic-scales of cold/dry and warm/wet conditions. The causes of this interplay is unclear for this period. Some researchers link the changes with global events, while others argue for sub-continental and/or

regional causes and effects. For example, Street-Perrott and Perrott (1990 and references therein) argue that SST and atmospheric circulation anomalies in the northern large water bodies (North Atlantic and Pacific oceans) influenced rainfall variability and lake levels in the tropics over the past 14,000 years. They observe that periods of arid conditions in tropical Africa during the past 14,000 years were associated with colder conditions and decreased salinity in the northern North Atlantic. Rossignol-Strick (1983 and references therein), using East Mediterranean sapropels (black organic-rich layers), shows that during the past 464,000 BP, tropical African lake levels have responded primarily to precessional low-latitude monsoon forcing with periods of 19,000 to 23,000 years. The sapropels are believed to be a consequence of heavy discharge from the Nile River, indicating humid conditions in East Africa. Rossignol-Strick observes that sapropels were deposited in the East Mediterranean Sea during the interglacials (c. 410,000; 291,000; 242,000; 200,000; 128,000; and 82,000 BP) and twice during glacial periods (c. 220,000 and 176,000 BP). Some humid conditions recorded in the deep East Mediterranean Sea support the above reviewed East African palaeoclimatic data. Undoubtedly, the interplay between cold/dry and warm/wet conditions during late Middle and early Late Pleistocene generated the present diversified environments and animal biomas in East Africa. Moreover, it created numerous opportunities for ecological isolation and

speciation. The reviewed palaeoenvironmental evidence suggests that short-term regional, rather than long-term global, scales of analysis and explanation are most appropriate for discussing the origin of AMH and for understanding past climatic processes.

Some researchers argue that such environmental changes were the milieu within which regional lithic differentiation and cultural identity and the modern human genotype and phynotype evolved in tropical and subtropical Africa (Clark 1988; Foley 1989). These conclusions arise because the climatic and environmental oscillations described above correspond with major biological and cultural change in the human lineage. Hominid fossil remains of anatomically "archaic" and AMH, ranging in age from > 200,000 to 130,000 BP, have been recovered in East Africa. In the archaeological record for this time-span, a shift occurs in the techno-typology of stone tool production from the predominance of handaxes and cleavers of the Acheulian techno-complex toward the type of core preparation and disc core technology that produced small flake implements of various forms. Clark sees such cultural changes as responses to the climatic and environmental oscillations during the Middle and early Late Pleistocene.

Drawing on the principles of evolutionary ecology, Foley (1989) observes that differences in environment can produce evolutionary diversity and marked differences in behavioral adaptations, leading to the emergence of new species.

Foley's model for the emergence of AMH combines both ecological and behavioral factors. He sees the dry and cold conditions during glacials and warm and wet conditions during the interglacials of late middle/late Pleistocene of Africa as the instigators of biological changes from late *Homo erectus* to anatomically "archaic" *Homo sapiens*; the finely graded woodland/grassland mosaic changed the archaic's ability to exploit those environments. This change in the foraging behavior of archaic hominids may have been the most significant variable in the emergence of AMH. Foley enumerates five main foraging characteristics. These include: 1) very large home range; 2) very large day range; 3) large group size; 4) high degree of sub-structure within groups; and 5) dietary selectivity. In Foley's reckoning, an increase in hunting ability was probably the most critical factor in the evolution of modern humans and their behavior. Unfortunately, Foley's model of the origin of AMH remains untestable in East Africa. The region lacks deep stratified sites with the palaeoecological data needed to test the social versus ecological models of modern human evolution. Foley's (1989, p. 312) list of foraging characteristics remains, by his own admission, "somewhat speculative as we do not know how many of these characteristics go back to the earliest AMH." As such, some researchers regard environmental selection on hominid skeletal forms and behavior as the only powerful and dynamic explanation for changes in the hominid fossil and archaeological record. I

argue that understanding the evolution of AMH and their behavior relies not only on a study of environmental/ ecological change, but also on an improved understanding of the archaeological record for this time span, a study which, in the recent past, has lagged behind in East Africa.

Stringer and Andrews (1988) have recently stated that earlier ancestral populations of AMH probably lived in an area intermediate between southern Africa and the Levant, perhaps in northern or Eastern Africa. East Africa is, in fact, a promising and necessary region for a more precise assessment of where, when, and how AMH and their distinctive behavior evolved. The region has revealed hominid fossil specimens that vary in form from anatomically "archaic" to anatomically modern *Homo sapiens*, making it possible to study the anatomical transition from "archaic" to "modern" *Homo sapiens*. Some of these hominid remains have been recovered either directly or circumstantially in association with pre-MSA and MSA lithic materials. In addition, East Africa contains archaeological deposits documenting the transitions from ESA to MSA and from MSA to LSA. Some of these deposits provide data for temporal resolutions as well. As will be shown later, a direct correlation exists between hominid biological and cultural evolution in East Africa. Also, it is noteworthy that East Africa contains sites with evidence of the early production of visual art, a behavior which some believe represents a full "modern" human cultural repertoire.

The morphologies of archaic and early *Homo sapiens* from East Africa have been summarized in detail by Bräuer (1989), Bräuer and Mehlman (1988) and Magori and Day (1983). Three localities are associated with fossil hominid remains in East Africa, while one other site is theorized also to be connected to MSA populations. These have been summarized by various authors including Allsworth-Jones (1993), Clark (1988), Mehlman (1989), and others.

Lake Eyasi, Tanzania. Fragmentary cranial remains of three hominid individuals were discovered by Kohl-Larsen on the surface eroding from the Eyasi lakeshore beds in the 1930s. These hominid remains are classified as anatomically "archaic" *Homo sapiens* (Bräuer 1984, 1989). During the research reported in this dissertation, I found a fourth hominid individual 100 m south west of Kohl-Larsen's Skull Site (see Chapter 7). The new hominid specimen designated Eyasi VI consists of a fragment of the occipital bone (Bräuer and Mabulla forthcoming).

A first intermediate industry locally known as "Njarasan" has been found from the fossil hominid site (Mehlman 1989). Also found at the site are bone remains of large mammals, seven of which are extinct forms. Chronometric dating of the Skull Site and its findings by amino acid racemization gave dates ranging from 34,000 BP to 36,000 BP (Protch 1981 cited in Mehlman 1989). On the basis of the extinct faunal species, these dates are too young to be accurate. Using a uranium-thorium dating of the Mumba

lower beds, Mehlman (1989) argues for an early date, possibly c. > 200,000 BP, for the Eyasi cranium and the first intermediate industries.

Laetoli-Hominid 18, Tanzania. The Laetoli hominid specimen (LH 18) is a mostly complete skull found *in situ* in the upper Ngaloba Beds of the Laetoli sequence (Magori and Day 1983). The cranium exhibits a mixture of morphological features from both "archaic" and "modern" *Homo sapiens*. It is variously classified as anatomically "archaic" by some (e.g., Bräuer 1984; Magori and Day 1983) and AMH by others (e.g., Rightmire 1986). The lithic assemblages from upper Ngaloba Beds have not yet been fully analyzed (Harris and Harris 1981). They are comparable to the upper Ndutu Beds assemblages (Leakey et al. 1972; Mabulla 1990) which combine heavy-duty and light-duty tool kits of the first intermediate industries. As noted earlier, the upper Ngaloba Bed and its findings were previously dated by uranium-thorium to 120,000 ± 30,000 BP (Hay 1987). Recently, an age of > 200,000 BP was established for LH 18 using the SCLF $^{40}Ar/^{39}Ar$ dating technique (Manega 1993).

Mumba hominid molar teeth, Eyasi Basin, Tanzania. Three hominid molar teeth attributed to the single individual, Mumba XXI, were recovered by Mehlman in 1977 from Bed VI-B of the Mumba rock shelter sequence, located approximately 3 km east of Kohl-Larsen's Skull Site. These molar remains have been classified as belonging to early anatomically modern *Homo sapiens* (Bräuer and Mehlman 1988). The molar remains

were recovered *in situ* in direct association with a MSA assemblage characterized by a lower ratio of Levallois technique and points/percoirs, and by an increase in the frequencies of side and notched/concave scrapers, bifacially modified pieces, and heavy-duty tools (Mehlman 1989). Mehlman named this early MSA occurrence the "Sanzako" Industry, a Hadzabe name for Oldeani Mountain. Uranium-series dates of 131,710 and 109,486 BP have been obtained for the Sanzako MSA and molar tooth's horizon (Mehlman 1989).

Kanjera hominids, western Kenya. Five fossil hominid remains were first discovered by L. S. B. Leakey at Kanjera in the 1930s. One of the hominid specimens was collected from the surface and the rest were found *in situ*. Recent fieldwork at Kanjera has recovered more fossil hominid remains (Pilbeam 1974; Pickford 1984; Plummer and Potts 1989, cited in Plummer et al. 1994). The Kanjera hominid remains, most of which are surface findings, have been a subject of controversy as their context remains unclear. The fossil remains are considered to be anatomically modern *Homo sapiens*. Leakey believed that the hominid remains were contemporaneous with middle Pleistocene faunal (L. S. B. Leakey 1972, 1974 cited in Plummer et al. 1994). Recent energy dispersive X-ray fluorescence (EDXRF) technique for provenancing fossil bone suggests that the Kanjera hominid fossils post-date the Kanjera Formation deposition and are thus younger than the associated Middle Pleistocene faunal (Plummer et al. 1994). Although MSA materials have been

found in the area, they were not convincingly associated with the hominid remains. Since the Kanjera hominids and MSA material have not even been assigned a relative date, their contributions to the ongoing debate on the biocultural origins of AMH are unclear (Clark 1988; Plummer et al. 1994).

Elive Springs, west Turkana, Kenya. This specimen consists of a cranium that exhibits both "archaic" and "modern" anatomical features of *Homo sapiens* (Bräuer and Leakey 1986; Bräuer 1989). The specimen comes from reworked deposits and was not associated with any archaeological material. No date or stratigraphic context has been assigned; however, the cranium has been tentatively classified as anatomically "archaic" *Homo sapiens* on the basis of morphological similarity with the Laetoli 18 specimen (Bräuer 1989).

Summary

The summary of research and the MSA and LSA hominid, cultural, chronological, and environmental records presented in this chapter illustrates a lack of regional approaches in previous research. The relative weakness of methods and theories employed for collecting data accounts for the failure to address broader anthropological and ecological processually oriented questions. The result of all these weaknesses is that we really do not have a reliable picture of hominid life during the MSA and LSA in East Africa. A second and equally important fact is that enormous gaps still

exist in the reconstruction of a regional culture-history and culture-processes for the MSA and LSA. The common problems that hinder this endeavor follow.

1) The samples that have resulted from low level research, small-scale surveys and excavations, and lack of archaeological visibility, especially for the MSA are very small. Moreover, few sites with long cultural sequences have been discovered, excavated, and fully described. As such, many lithic and faunal assemblages are surface findings either without context, without chronological control, or both. A regional culture-history necessarily requires a synthesis of a large body of archaeological data from archaeologically stratified sites within the region. Without this large body of data, cultural variables and their change through time and space cannot be meaningfully identified and described, and the regional culture-history cannot be established.

2) Too few reliably dated MSA and LSA sites exist in East Africa to provide the necessary chronological framework for establishing a regional culture-history. This unwelcome situation has been caused by the fact that MSA and early LSA periods are beyond radiocarbon and conventional K-Ar dating techniques. Many of the other chronometric dating techniques are still either in their developmental stages or are unreliable. A scarcity of dateable materials from archaeological contexts further hampers efforts. Therefore, many MSA and LSA materials in East Africa are assigned

relative dates based on techno-typology and stratigraphic correlation with chronometrically dated strata or excavated assemblages. Nonetheless, the recent dates by Manega (1993) have helped reveal a very different picture of the biocultural development of MSA and LSA in East Africa, one that indicates its deep and ongoing roots into the African Middle and Late Pleistocene times.

3) Many of the culture-stratigraphic entities of MSA and LSA have been defined from rock shelter sites. Compared to open sites, rock shelters provide the sediment-traps that allow a good assessment of culture-stratigraphic succession and change, continuity and discontinuity. Reliance on data from rock shelters, however, creates a major problem in establishing a regional culture-history as culture changes may reflect local changes rather than regional trends.

4) A lack of accepted typology or working vocabularies has also been a major impediment to the robust establishment of a MSA and LSA regional culture-history. For instance, while Mehlman (1989) insists that the three Stone Age system (Early, Middle, and Later Stone Age) should be a five stone age system to include the two transitional industries (First and Second Intermediate), Clark (1988) and Masao (1992) argue that assemblages that belonged to the First Intermediate (e.g., "Sangoan") should be viewed as early MSA. Without an adequate terminology that can allow understanding between scientists, communication is rendered difficult, and discourses about culture-history and processes becomes quite

confused. So far no one typology has produced a descriptive scenario that a majority of archaeologists acknowledge. Whereas site-specific typologies are most adept at providing the fullest description of a site's lithic assemblages, the use of common typologies is much more conducive to regional culture-history and processes (Mehlman 1989). Such a regional typology for the MSA and LSA is lacking in East Africa, although some progress has been made in recent years (e.g., Merrick 1975; Mehlman 1989). Nevertheless, it appears that new, more rigorous, more rational, more systematic, computer assisted typological studies are needed for the East African MSA and LSA.

What is required to remedy the problems that inhibit our understanding of MSA and LSA in East Africa is long-term research, systematic surveys, extensive excavations, and intensive analyses at a range of sites selected for their ability to yield data on activity patterns, including subsistence practices, and the organization of technology. Reliable dating at the limits of radiocarbon and conventional K-Ar techniques is needed to understand the timing and processes of biocultural change during the MSA and at the MSA/LSA transition (see also Marean 1990).

Even more importantly, we need research strategies that are solidly based on and derived from the premise that reasonable reconstructions of the cultural life ways of MSA and LSA can be achieved by examining how hominids distributed themselves across the landscape. Our goal must be to

understand the relationships between various components (e.g., economic and cultural) of specific human behavior with the associated non-cultural processes (e.g., ecology, geomorphology, geology) for any time and area. This task requires an alternative archaeology that focuses on discerning and identifying the spatio-temporal distribution of prehistoric foragers with their cultural traditions. The present project was conceived in an attempt to begin this investigative process in the Eyasi Basin. The succeeding chapters describe my research strategies and findings.

CHAPTER 4
THE SETTING: LANDSCAPE, GEOLOGY, ECOLOGY, AND ARCHAEOLOGY OF THE EYASI BASIN

Introduction

Landscape is a rather general and multidimensional term defined by the research problems and goals. As such, definitions of landscape are many and varied ranging from the artistic view of scenery to cultural and physical landscapes in human geography (Naveh and Lieberman 1990; Schreiber 1990). In this dissertation, I define "landscape" as the setting for "adaptive strategies" played out by humans over an extensive spatial area. Accordingly, landscape is the total terrestrial context that bears the imprint of a shared set of either physical attributes, cultural values, or both (see also Crumley and Marquardt 1990; Marquardt and Crumley 1987).

People use the landscape for many purposes, ranging from resource procurement, production, utilization, and formal design, to the more or less explicit expressions of their position in the physical world. The relationship between people and the landscape in which they live or have lived is, therefore, of great importance to archaeologists. Understanding the nature of this relationship helps to

explain the behavioral adaptations of both past and contemporary human societies.

This chapter assesses the physical factors that may have interacted to influence MSA and LSA forager behavior and culture and how they were patterned in the Eyasi Basin, particularly those relating to land-use and resource utilization. Chapter 5 addresses the cultural elements of modern forager land-use systems and adaptations in the Eyasi Basin. The first objective of this chapter, therefore, is to appraise the terrestrial characteristics of the Eyasi Basin and to analyze the forces that formed the Basin's present-day landscape. Geologic, geomorphic, and ecologic components take on particular importance in this analysis because land-use, resource procurement and utilization, and other human adaptive behaviors and cultural systems are related to dynamic ecologic, geologic, and geomorphologic changes.

Particular physical factors can act independently or in various combinations to directly condition human behavior and the distribution of human activities on the landscape. Ecologic and geologic processes, for example, may combine to determine regional geomorphology. Regional geomorphology and ecology can, in turn, combine to control drainage patterns, set limitations on shelter and other comfort considerations, and ultimately influence flora, fauna, and human geography. Furthermore, physical elements determine landscape vulnerability. The combination of geomorphologic, pedologic, geologic, climatic, and vegetation factors, for example,

determine the vulnerability of the landscape (e.g., to weathering and erosion). Weathering and erosion shape flora and fauna distributions and influence human usage of the landscape.

Studying the relationships among various physical and cultural elements of the landscape reveals what resources were available for human use at any particular time and what aspects of the landscape were most important to human life. This requires an understanding of the present economic and ecological potentials of the landscape for human survival. Accordingly, the second objective of this chapter is to analyze the regional economy and social structure of the present inhabitants of the Eyasi Basin. This information will be of particular importance when considering present and past forager adaptations in the Eyasi Basin (Chapters 5, 9, and 10).

Much of the geologic and geomorphologic data on the Eyasi Basin date from the colonial period (Eads and Reeve 1938; Orr and Grantham 1931; Willis 1936) or from shortly after independence (Baker et al. 1972; Dundas et al. 1964; Pickering 1964; Schultz 1967). These works remain, after six decades, the principal source of information for this region. This chapter is largely based on this body of literature and on data from my own field work. A review of this information allows us to better understand the characteristics of the Middle and Late Pleistocene landscape that formed the setting for forager occupation and utilization of the Eyasi Basin.

By focusing first on the primary context in which prehistoric activities took place, this chapter examines what Gould (1990) calls first-order explanations before moving on to investigate higher-order ones. The latter refer to aspects of cultural behavior and the former to measurable aspects of the landscape. The study, therefore, begins with variables that are tangible and moves on to those that are increasingly less tangible. In the following section, I define the regional parameters of this study.

The Study Area: Eyasi Basin

The Eyasi Basin (Figure 4-1) can be defined geographically, geomorphologically, and culturally. Geographically, the Eyasi Basin is that region in Mbulu district, northern Tanzania, that lies between latitudes 3°20'-4°05' S and longitudes 34°50'-35°30' E. It is located about 200 km southwest of Arusha town and 50 km southwest of Karatu town (Figure 4-1).

The region is characterized by block-faulting and volcanoes at the southern termination of the East Rift Valley (ERV) system. It is marked by two major grabens (the Mang'ola and Yaeda-Endanyawishi Grabens), a horst, several unbroken plains with isolated hills and inselbergs, valleys, and fault escarpments that range from 1030 m to 2030 m above sea level (a. s. l.) (Figure 4-2).

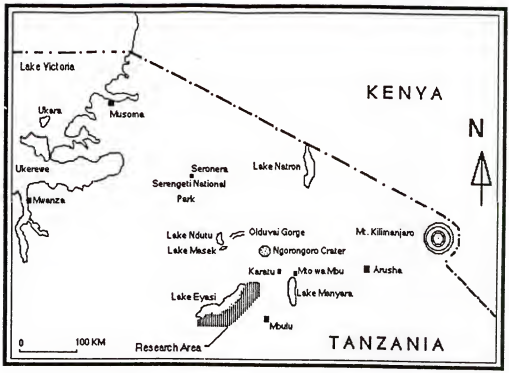


Figure 4-1: Map of Northern Tanzania Showing the Research Area.

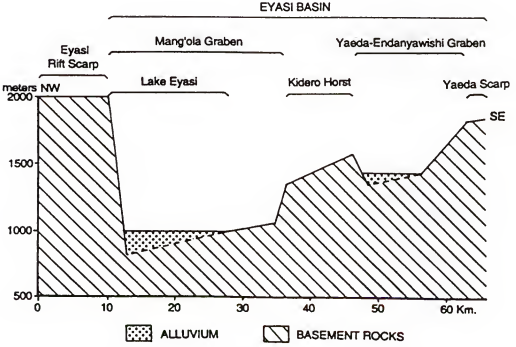


Figure 4-2: A Cross-section Profile of the Eyasi Basin (Across A-A', Figure 4-4). (Adapted from Schultz 1967).

Culturally, the Eyasi Basin refers to the country east and south of Lake Eyasi which has been utilized for centuries (if not millennia) by Hadzabe foragers. Sometimes I refer to this area as the Hadzabe landscape, that is, the "eco-space" where Hadzabe socio-cultural and economic activities historically and habitually occurred. According to Woodburn (1964), the Hadzabe had this country largely to themselves at the time of European contact around the beginning of the last century. Local incursion by farmers and pastoral groups have been recorded in historic times as early as the beginning of the 19th century (McDowell 1988; Obst 1912; Woodburn 1964, 1988). Nevertheless, archaeological evidence indicates the presence of farmers and pastoralists over several millennia (Mehlman 1989; John Sutton 1992, Personal Communication). As will be shown in Chapter 5, this "eco-space" plays an important role in the definition and expression of Hadzabe social organization, subsistence, and land-use patterns. Altogether, the Eyasi Basin covers an area of about 2,500 km^2.

Geology

Three rock systems are found within the Eyasi Basin (Figure 4-3). The lowest of these is the Precambrian or Archaean rock system, which can be subdivided into lower and upper units. The lower unit is composed of banded gneisses, pelitic-schists, hornblendes, mica-schists, altered diorites and granito-gneissic rocks (Pickering 1962; Saggerson 1962

cited in Tanaka 1969). Quartz and quartzite veins, granodiorites, migmatites and pegmatitic intrusions (e.g., at Gordfani hill) occur in association with these metamorphic complexes (personal observations 1992-1993). The upper unit consists primarily of metavolcanics, quartzites, chlorite schists, hornblende schists, and conglomerates. Slates and metasediments are predominant and are intruded by granitic bodies (Saggerson 1962 cited in Tanaka 1969). These rocks range in age from c. 3.1 to 2.5 billion BP (Cahen et al. 1984).

Mozambiquian rocks unconformably overlie the Precambrian rocks (Cahen et al. 1984). In the Eyasi Basin, these rocks occur in the eastern portion and are composed of granulite rocks that are associated with gneisses of the amphibolite facies. These rocks range in age from c. 950 to 400 million BP (Cahen et al. 1984).

Neogene rocks include the Pliocene-to-recent rift volcanic rocks that bound the Eyasi Basin to the north, along with a few occurrences at the far northeastern end of the lake shore (Figure 4-3). These rocks include pyroclastics, basaltic and trachytic lavas of Lemagrut, Oldeani, and Ngorongoro and nephelinitic pyroclastics and lavas of Sadiman (Pickering 1964). Nephelinite rocks also crop out near the south-east corner of Lake Eyasi and at Laetoli. These volcanic rocks range in age from c. 4.3 million BP to recent (Manega 1993). In addition, Plio-Pleistocene to recent sediments occur within the Eyasi Basin. These sediments are

widespread and consist of lake beds, tuffs, alluvium, delta fans, screes, and alluvial sands.

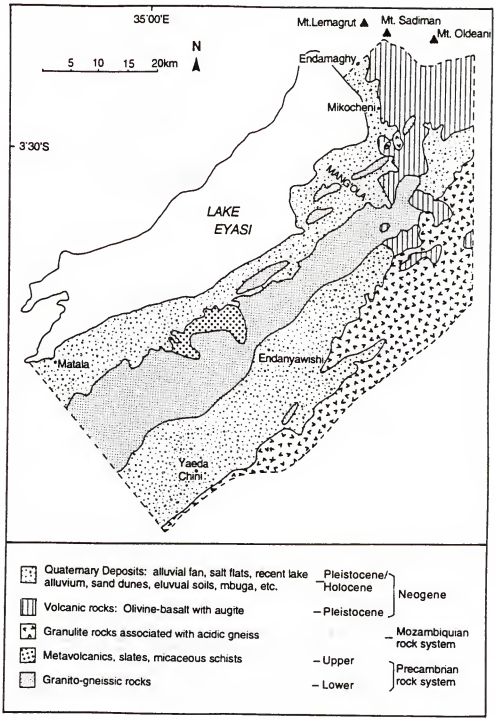


Figure 4-3: Geology of the Eyasi Basin.
(Adapted from Dundas et al. 1964; Pickering 1964; Tanaka 1969; Schultz 1967).

Evolutionary History of the Eyasi Basin

Both previous research and the present study demonstrate that the Eyasi Basin has been occupied by hominids since the Middle Pleistocene (Chapters 3, 4, 7 and 8), about 200,000 BP. Understanding how MSA and LSA hominids used the Eyasi Basin constitutes a major objective of this study. Before one can even attempt to infer hominid land-use patterns from surface and sub-surface artifact distributions, however, it is necessary to understand the nature and past history of the land surface. In this section, I examine the Eyasi Basin, not as a hypothetical landscape, but as a dynamic and complex landscape system. In doing so I hope to evaluate the relevance of the modern Eyasi Basin landscape for the archaeological record (see Chapter 7).

Information suggests that crustal movement with either downthrow or uplifting was the major force behind the geological evolution of the Eyasi physical landscape. As stated previously, such physical changes of the landscape can in many ways condition human use of the landscape and its resources. Consequently, it is imperative to understand how the modern landscape of the Eyasi Basin came into being. This section presents a summary of the geomorphological history of the Eyasi landscape. The purpose is to examine how changes in the terrain may have affected prehistoric human land-use and adaptations in the Eyasi Basin.

To understand the evolution of the Eyasi Basin, it is necessary to refer to the neighboring regions, particularly to the north. The tectonic forces which led, in great part, to the development of present-day structures and landforms find their greatest expressions in the northern part of the region. Furthermore, much geomorphologic information for the Eyasi Basin can be deduced from works that address the northern area.

In his study of plateaus and rift valleys, Willis (1936) observes that the surface of East Africa was flat before the uplifting and subsequent volcanism. This flat topography changed during the Pliocene when the eastern side of Africa from the Red Sea to Mozambique was initiated by continued regional tectonic activities (Willis 1936). Lateral tensions produced a series of faults that generally trend from either north to south, north-east to south-west or from south-east to north-west, producing the East African Rift Valley (EARV) system (Willis 1936). The EARV is characterized by several rift basins and lakes which tend to be bounded by either the faults and/or constructional volcanic centers that accompanied regional tectonics. In northern Tanzania, regional tectonism is represented by several fault scarps, basins (e.g., Olbalbal depression), and lakes (e.g., Lakes Natron, Manyara, and Eyasi). The constructional volcanic centers to the north of the Eyasi Basin have recently been studied by Manega (1993). These include the Lemagrut, Olmoti, Sadiman, Ngorongoro caldera, Mosonik, Oldonyo Lengai

and others. These tectonic and volcanic features dominate northern Tanzania.

In the Eyasi Basin, the main structural features of regional block-faulting and volcanism are the Eyasi rift scarp, the Kidero horst, and the volcanic mountains to the north. The order of faulting and volcanism in the Eyasi Basin is not clear. This is due to subsequent erosional and depositional activities that have erased much geomorphic information, and research is scanty. Nonetheless, at least four stages of faulting and three stages of volcanism can be deduced from the available data.

The faulting of stage one is associated with the Pliocene regional block-faulting that initiated the Eyasi rift scarp. This early faulting may have taken place as early as Miocene (Baker 1986; Pallister 1971, cited in Manega 1993; Baker and Mitchell 1976; Pickering 1964). This faulting activity was followed by the volcanism that built up the extinct volcanoes of Sadiman, Essimingor, and Mosonik. This earliest volcanism occurred from about 3.4 to 2.7 million BP (Manega 1993).

A second tectonic phase occurred at about 2.4 to 1.9 million BP, initiating the Natron-Manyara fault. This was accompanied by the formation of the Natron and Olduvai Basins (MacIntyre et al. 1974). The faulting of stage two occurred at about the same time as the volcanism that formed the Lemagrut and the Ngorongoro Volcanic Highlands (NVH), between 2.5 to 1.5 million BP (Manega 1993). The faulting of stage

two deepened the Mang'ola Graben. Nonetheless, the associated volcanic construction of the NVH blocked the drainage into Lake Eyasi and formed a lake south of Oldeani Mountain (Pickering 1964) in the area known today as either "Kambi ya Simba" or "Kambi ya Mkaa". The overflow from this lake cut the channel that is today followed by the Mbarai River to Lake Eyasi.

The faulting of stage three probably took place between 1.3 million and 900,000 BP when the present-day Natron-Manyara escarpment was formed (Fairhead et al. 1972; McIntyre et al. 1974). This phase of faulting was followed by the building up of the younger extrusive cone of Embagai in the north between 1.2 million and 500,000 BP (Manega 1993). These effects may have extended further south to the Eyasi Basin (e.g., Oldeani Mountain).

The fourth and latest major stage of faulting and volcanism in the region took place around 800,000 to 400,000 BP (Manega 1993; Somi 1993). This faulting episode displaced the Laetoli beds and Olduvai lake beds and formed the Olbalbal Depression that lies east of Olduvai Gorge and north of the Eyasi Basin. This faulting event is also associated with volcanism in other parts of northern Tanzania (Manega 1993), although it is not clear if its magnitude extended into the Eyasi Basin.

The existing data, therefore, suggest repeated faulting along the NE-SW Eyasi fault scarp. The nature of this faulting demonstrates that crustal movement, with regional

block faulting and volcanism, was the major force behind the evolution of the Eyasi Basin. The general faulting trend is NNE-SSW throughout the areas we surveyed, with some local deflections of less than 15° due to lateral faulting and displacement. Basement rocks are inclined at a high angle, generally dipping to the east at 40°.

In this study, geomorphologic investigations of the lake sediments on the northeastern shore of Lake Eyasi show no evidence of tectonic disturbances since the last faulting event (Chapter 7). The modern Eyasi topography is, therefore, a result of recent erosion and deposition. Hominid occupation in the Eyasi Basin began after the last faulting event, about c. 200,000 BP (Mehlman 1989).

Middle and Late Pleistocene Environments

The study of the Eyasi Basin's past environments is limited by a lack of detailed chronological and palaeoecological studies by experts in these fields. Previous research (Mehlman 1989; see also Chapter 7) has noted evidence of ancient highstand water levels, but no detailed investigations of this phenomenon have been conducted. When properly studied, the sediments of the Eyasi Basin hold a key to unraveling the interplay between tectonism, volcanism, sedimentation, climate, and biota in a rift system.

The available sedimentary data, as summarized by Mehlman (1989), suggests periods of interchanging moderate wet and

dry conditions as indicated by the lake levels. Two stratigraphic formations have been recognized for the Eyasi Basin sediments: the Eyasi and Mumba Beds. The Eyasi Beds have been defined from the exposed and eroded lacustrine sediments near the modern lakeshore. On the basis of extinct faunal (*Theropithecus, Pleorovis, Hipparion,* a giraffid, a large carnivore, a hippo, and an antelope), the Eyasi Beds are assumed to have been laid down during the Middle Pleistocene (Mehlman 1989). The beds contain layers of reddened, zeolite-cemented, and clay-pellet aggregates alternating with layers composed of lacustrine clays, sands, and gravels. The lithology of the Eyasi Beds suggest fluctuating low to moderate lake levels in the Basin during a prolonged interval of strong alkaline chemical environments under the influence of a semi-arid and cool climate (Mehlman 1989). Nevertheless, the widely distributed remains of hippo, wildebeest, bush pig, waterbuck, reedbuck, and impala suggest the presence of nearby vegetation and water resources (Mehlman 1989).

The Mumba Beds are a younger formation, > 10 m thick and subdivided into six units ranging from Bed I at the top to Bed VI at the bottom. These beds consist of rock shelter deposits that have been defined from the Mumba rock shelter, located 3 km east of the modern lake shore. The deposits of unit VI-B of the Mumba sequence have coarse grained sand, contain little CaCO3 and lack clay pellets; these characteristics indicate a fluctuating high lake, at least 20

m above the modern level. Unit VI-B has been dated by uranium series to 130,000 BP (Mehlman 1989). Highstand lake levels at about this time also have been reported in the Manyara and Natron-Magadi Basins and other areas in East Africa (Somi 1993; see Chapter 2).

Unit VI-A is dominated by clay-pellets and CaCO3 in the lower bed, features that indicate a medium to low lake level, and sand and cobbles in the upper, suggesting a high to medium lake level (Mehlman 1989). The lower part of unit VI-A is estimated to be between 110,000-70,000 and the upper 70,000-60,000 BP. A highstand lake level dating to about 90,000 BP also has been noted in the Manyara Basin (Somi 1993; Chapter 2). This interplay of wet and dry conditions, as indicated by fluctuating lake levels, continued in the Eyasi Basin until 3,000 to 2,500 BP when the modern shoreline was reached (Mehlman 1989). However, the faunal assemblage of Mumba Beds is dominated by present-day species that are adapted to semi-arid environments. The presence of equids, bovids, and other "savanna" environment animals suggests that the climatic conditions were perhaps drier than that inferred by Mehlman from sedimentary data. The bulk of the Mumba Beds faunal seems to indicate environmental conditions and a combination of habitats similar to those prevailing in the Eyasi Basin today (Mehlman 1989).

From the foregoing discussion, it is possible to deduce that the present-day environments and habitats in the Eyasi Basin can be traced back in time to the beginning of the late

Middle Pleistocene. Although the environment has been fluctuating through time, the magnitudes were not great enough to adversely affect the distribution of flora and fauna in the Eyasi Basin. Therefore, present-day environments and habitats may be assumed to broadly represent those of the past 200,000 BP.

The Eyasi Basin: Modern Landscape

The contemporary Eyasi Basin land system is an assemblage of residual tectonic landforms, each in the process of being transformed by erosion. Deeply eroded escarpments and "gullies" dominate. Nonetheless, erosion has not leveled off all features of tectonic origin, possibly due to the short geological history involved.

The available literature, along with personal field observations, has led me to distinguish three major geomorphic features within the Eyasi Basin: 1) the Mang'ola Graben; 2) the Yaeda-Endanyawishi Graben; and 3) the Kidero Horst (Figure 4-4). Each is a distinct geomorphologic feature. Yet, the connection between them is evident, arising from the earth movements and erosion that have affected the area as a whole. The prehistoric and ethnographic connection between these three geomorphic features is also evident; all three features presumably were traversed extensively by prehistoric foragers and they are still being traversed by modern-day Hadzabe foragers (Chapters 5 and 6). Within these major geomorphic features,

several isolated rocky hills and inselbergs appear, sometimes separated by either small valleys or gently unbroken plains.

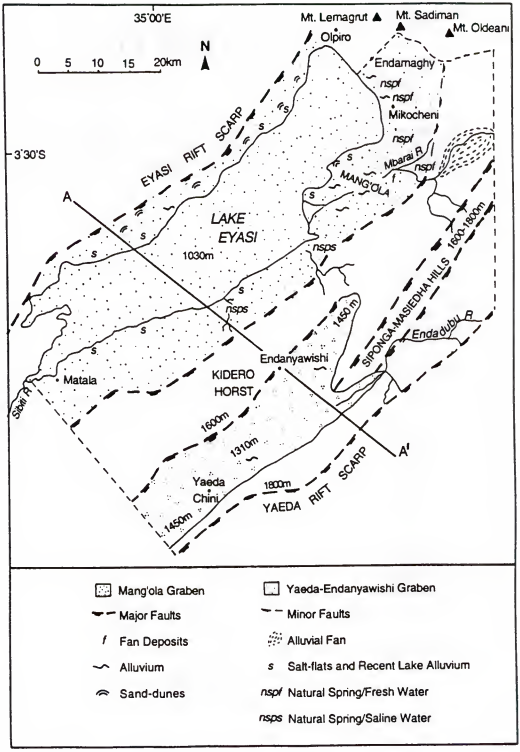


Figure 4-4: Geomorphology of the Eyasi Basin. (Adapted from Dundas et al. 1964; Schultz 1967; Willis 1936).

The Mang'ola Graben

The Mang'ola Graben is about 35 km wide and 100 km long. On the northwestern and western sides, it is bordered by a line of high, sharp fault scarps known as the Eyasi Rift Escarpments (Figure 4-4). These rift scarps are the main structural feature of regional block-faulting in the Eyasi Basin (Pickering 1964). The Eyasi Rift Scarps vary in height from 600 to 1,000 m above the level of the valley floor, or an average of approximately 1030 m a. s. l. (Pickering 1964; Tanaka 1969). These escarpments are vertical cliffs which have been deeply dissected by short ephemeral rivers and streams. The maximum height of the escarpment occurs in the center; the scarp then gradually diminishes toward the southwest merging into the Wembere-Manonga Depression (Eades and Reeve 1938; Willis 1936). These Eyasi Rift Escarpments trend SW-NE from the southern end of Lake Eyasi to join Mount Oldeani in the northeast.

The Mang'ola Graben is bounded in the north by a series of extinct volcanoes. These include Sadiman (2,892 m; ≥ 3.3 million BP), Ngorongoro (~ 2,000 m; ≥ 2.0 million BP), Lemagrut (3,162 m; 1.9 million BP), and Oldeani (3,218 m; age unknown) (Pickering 1964; Manega 1993). These extinct volcanoes, however, cannot be regarded as the end of the Eyasi fault fractures in which they have arisen; beyond these volcanoes, fractures continue on into the Olbalbal-Sonjo rift fault (Manega 1993; Willis 1936). The Mang'ola Graben is

dominated by major faults which trend from SSW to NNE and by minor faults occurring in the area drained by the Mbarai River along the flanks of Mount Oldeani (Pickering 1964). Most of these faults are broadly contemporaneous with the formation of the EARV (Pickering 1964). To the east tending southeast, hills of old basement rocks gently slope downward toward the Kidero Escarpments or Horst. The southern wall of the Mang'ola Graben is geomorphologically ill-defined, but is believed to be represented by a low northward-facing scarp that drops down into the Wembere-Manonga Depression (Williams and Eads 1938; Willis 1936).

The floor of the Mang'ola Graben is cut by many westerly, southerly, and northerly directed stream channels, some of which empty into the lake. Near the lake, the terrain becomes extremely flat and the velocity of stream and river channels decreases dramatically. Consequently, numerous deltaic fans have built up along the edge of Lake Eyasi (Figure 4-4). Similar deposits are found near the foot of Mount Oldeani where they coalesce and form sheets of sand and gravel (Figure 4-4); these become finer in grade near the lake (Pickering 1964).

The area drained by the Mbarai River (lower Mbarai) is characterized by gravel, alluvial, and silt deposits that represent the final stage in the infilling of the ancient Lake Eyasi (Pickering 1964; personal observations 1992-1993). These river deposits provide the resource for present agricultural activities in the area (see Chapter 5).

The Lake Eyasi Beds are very eroded, and most of their outcrops are composed of red or grayish alluvial sands and silt. Sometimes the lake beds are covered with crescent dunes of wind-blown sands and silt (Pickering 1964; personal observations; Figure 4-4). Salt-flats and recent lake alluvium and swamps are common features along the lake shores. Pyroclasts, tuffs, and volcanic ashes are found in the northern part of the Mang'ola Graben.

The floor of Mang'ola Graben is characterized by many gullies, inselbergs, and rocky outcrops suggesting intensive erosion activities. Erosion rates are very high. Field observations during the 1992-1993 rainy season suggest erosion rates of up to c. 10 mm per year. Eroded materials are deposited either as alluvial soils or as fans in valley bottoms, the lower Mbarai River, and in the lake.

The Yaeda-Endanyawishi Graben

Before this dissertation, the Yaeda-Endanyawishi Graben was known as the "Hohenlohe Graben" and "Yaida Graben" in Willis' and Schultz's reports, respectively. I choose instead to identify this graben with the names of its two largest villages (Yaeda, in the south, and Endanyawishi, in the north). Willis describes the Yaeda-Endanyawish Graben as a relatively depressed basin located east of the Kidero Horst (Figure 4-4). The margins of the graben are marked by the Kidero (in the west) and Masiedha-Siponga and Yaeda (east)

fault scarps that trend NE-SW. The two fault scarps run nearly parallel toward the northeast (Willis 1936).

The basin floor averages 1300 m a. s. l. and is slightly convex in the south-west near Yaeda Chini (Eads and Reeve 1938). The graben is characterized by gneiss inselbergs and rocky outcrops, and is fed by north-westerly and south-westerly directed streams. Few fan deposits have built up within the graben. Black cotton soils and recent alluvium dominate the graben's soils. Where not covered by recent alluvium, the outcrops consists of characteristic gneisses. As Willis (1936) observed, the graben was continuous with the plain in the north and south before faulting altered the relative positions of the blocks. The floor, 40 km long, ranges in width from 10 to 16 km.

The Kidero Horst

The Kidero Horst is located between the Mang'ola and Yaeda-Endanyawishi Grabens (Figure 4-4). This horst, as described succinctly by Willis (1936), reaches its highest in the north and widens in the south. The Kidero Horst is deeply cut by streams that run into the two grabens and is thus characterized by rocky outcrops and deep valleys and gullies.

Ecological Factors

Ecological factors are here taken to include biotic and abiotic factors that interact to influence human life in a particular landscape. For the purpose of this study, these factors include climate (temperature, rainfall, evapotranspiration and humidity), drainage systems, soils, vegetation, and human food resources. Since my research strategy involved sampling different ecozones for survey, an overview of the ecology of the Eyasi Basin is necessary. The following sections, therefore, present general descriptions and distributions of the present climate, drainage patterns, soils, vegetation cover, and the available human food resources of the study area.

Present Day Climate

As a statistical expression of daily weather events averaged over the years, climate varies on all temporal and spatial scales. In the Eyasi Basin, at least two major climatic seasons can be characterized on the basis of changes in rainfall, temperature, and winds. These are the dry and wet seasons. Of the three climatic elements named above, rainfall is the most significant and active variable in the Eyasi Basin.

Though the timing varies somewhat from year to year, the dry season generally runs from late May to late October. During this time the area receives hardly any rainfall. The

wet season begins in November and ends in early May. Generally, the month of February divides the wet season into the short (*vuli*) and long (*masika*) rainy seasons. Therefore, the short rains come between November and January, and the long wet season occurs in March/April to May. Although the rain typically falls in a bimodal pattern, the short rains can fail entirely, especially in the Mang'ola Graben. This is because the Eyasi Basin lies in west-northwest, in the rain shadow of the Mbulu Highlands that rise to c. 2,400 m a. s. l. Consequently, the moisture bearing SE monsoon winds do not bring total annual moisture to the Eyasi Basin. This is demonstrated by westward decreases in annual rainfall, reaching about 300 mm in the Mang'ola Graben (Figure 4-5). The annual average rainfall for the Eyasi Basin is about 450 mm ranging from 300 to 600 mm (Bunn et al. 1988; Schultz 1967; Tomita 1956, cited in Tanaka 1969; Figure 4-5). Almost half of this amount comes in March and April.

Long-term temperature data are lacking for the Eyasi Basin. The temperature is somewhat higher during the wet season (Tanaka 1969). Over the course of my research, the mean monthly maximum temperatures were almost uniform, ranging from 25° to 30° C during August to February. High temperatures of c. 30° C are expected during the long rainy season in March and April. The minimum temperature is reached between June and July, perhaps falling as low as 20° to 22° C (Richard Mrema, personal communication 1993).

During the dry season, winds blow steadily westward. Whirlwinds that create localized storms are also common during the dry season (Tanaka 1969). The wind patterns change during the rainy seasons. They are not as strong as in the dry season and their directionality varies depending largely on the location of low pressure areas.

According to Schultz (1967), the potential annual evapontranspiration of the Eyasi Basin ranges from 800 to 1,200 mm (Figure 4-6). A comparison of potential evapotranspiration to the annual rainfall of 300 to 600 mm clearly shows that the potential evapotranspiration is much greater than precipitation, accounting for the prevailing arid climate. Evapotranspiration is so extreme that the more soluble salts in the soil water are precipitated; the relatively insoluble carbonates form calcrete nodules.

Soils

Many factors are known to interact to produce a variety of soil types. These include parent material, climate, topography, age, vegetation, and previous land-use patterns (Lind and Morrison 1974). In the Eyasi Basin, basement rocks (bedrock) crop out extensively, and thick soils are found only in areas that are filled with alluvium. These include the riverine systems, marsh habitats, and valley bottoms.

The lower Mbarai flood plains, for example, consist of thick soils of derived red or grayish sands and silts. Rich

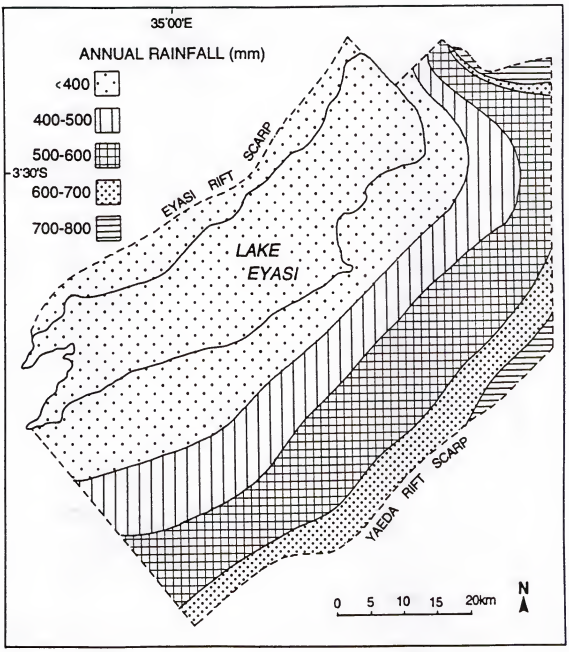


Figure 4-5: Annual Rainfall in the Eyasi Basin.
(Adapted from Tanaka 1969; Schultz 1967).

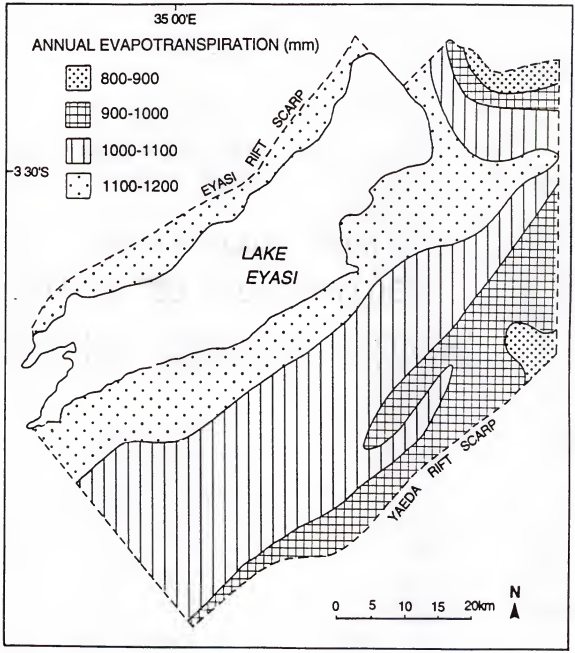


Figure 4-6: Annual Evapotranspiration in the Eyasi Basin. (Adapted from Schultz 1967).

loamy soil mixed with volcanic ash is found along the northeastern lake shore in Mikocheni and Endamaghay and in the low-lying marshes. The Yaeda-Endanyawishi Graben is notable for its rich grayish-black clay soil that shrinks and cracks during the dry season and becomes a quagmire in the rainy season. According to Lind and Morrison (1974), such valley bottom soil types are less degraded and contain a much higher proportion of montmorillonite clays. These soils absorb water and expand as a consequence. Their dark color is believed to be due to a clay-humus complex.

The largest part of the Eyasi Basin consists of poorly developed red-to-brown calcareous soils. This condition occurs because of several geologic and climatic factors, such as the underlying basement rock, high temperatures, erratic rainfall, high evapotranspiration rates, and strong surface winds. In the north, along the slopes of Oldeni and Lemagrut, this poorly developed soil mixes with volcanic ashes and alluvium. The lacustrine plain consists of poor light gray sand.

Drainage System

The Eyasi Basin lies within a region of internal drainage. The most prominent hydrographic feature in the region is Lake Eyasi, standing at approximately 1,030 mm a.s.l. The present Lake Eyasi runs for about 75 km from northeast to southwest and has a maximum width of about 18 km, only partially filling the basin. Roughly, the lake

occupies an area of c. 1,350 km^2 during a "good" rainy season, covering all the "salt-flats". Lake Eyasi is so shallow that it almost dries up during the dry season, leaving a thin crust of salts (NaCO3 and NaCl). The main source of these alkali carbonates is probably the weathering of volcanic rocks in the area (Orr and Grandtham 1931; Willis 1936).

Almost all the streams and rivers, except those associated with the springs mentioned below, are ephemeral. They drain into valleys, plains, and Lake Eyasi (Figure 4-7). The Mbarai River, despite a large catchment formed by a wide area of the highland lands of Oldeani and Karatu, dries up during the dry season. With only seasonal runoff, the rivers and streams do not transport all the massive sediment load furnished by chemical and mechanical weathering. The Mbarai River, rather than entrenching its valley, floods across an extremely flat wash plain. This seasonal flooding is a common feature of the lower Mbarai River, destroying the agricultural products in farmlands along the river.

The Yaeda, Endadubu, and Udahya Rivers are possibly semi-perennial as we found them with low volumes of water during the dry season. The Sibiti River is the region's only perennial river. The Sibiti, which drains into the southern end of Lake Eyasi, collects its waters from the southern plains and possibly from as far as Lake Victoria through Smith Sound (Mehlman 1989). The dentritic drainage pattern

of the streams and rivers is related to the basement (metamorphic) rocks of the region (Figure 4-7).

Tanaka (1969) has given a full account of the various natural springs, their utilization, and distribution in the Eyasi Basin (Figure 4-7). The number of individual springs is large since springs often consist of a large number of seepage points rising from the faults and shearing zones, and unconformities of strata. The high water table for the natural springs is fed by ground water flow from the humid mountain slopes of Oldeani and Lemagrut, and ground water that crops out from the surface of the salt-flats forming natural springs and perennial streams that vary from saline to fresh water (Pickering 1962; Tanaka 1969). Some of the springs are hot, with recorded temperatures of 39° C (Pickering 1962; Tanaka 1969). These hot springs are believed to emerge at the contacts between the basement rocks and the overlying rift sediments (Somi 1993).

Pickering estimated the discharge of these natural springs to be of the order of 1,134,000 litres per day in 1961, but Tanaka's study and my field observations suggest a greater discharge at present. The availability of fresh and potable water from the perennial natural springs in the northeast portion suggests that the Eyasi Basin was capable of supporting prehistoric forager groups.

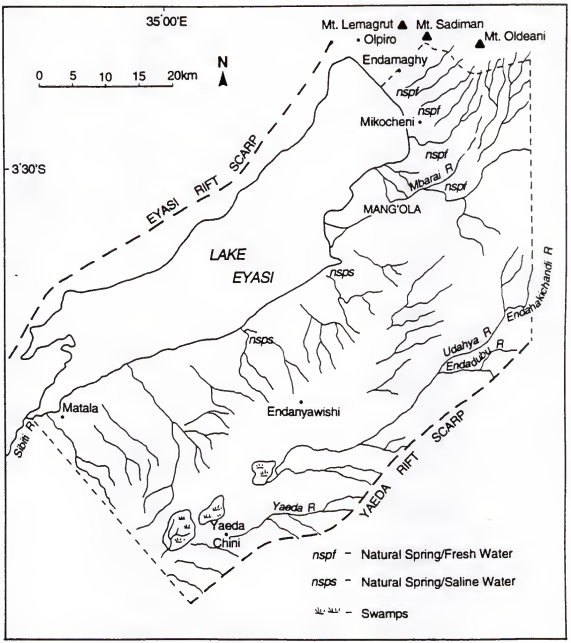


Figure 4-7: Drainage System of the Eyasi Basin.
(Adapted from Dundas et al. 1964; Schultz 1967).

Vegetation

Vegetation patterns are largely influenced by topography, climate, and soil type (Lind and Morrison 1974). In the Eyasi Basin, where rainfall averages 450 mm, the direct effect of rainfall on vegetation types is great. In addition, the features of topography, soils, and evapotranspiration are all important (Schultz 1967; field observations).

The Eyasi Basin is primarily a semi-arid region with sparse vegetation. Low rainfall, high daily temperatures, and the character of the prevailing basement bedrock combine to produce a semi-arid landscape. On the basis of the distribution and species composition, the vegetation of the Eyasi Basin is a mixture of 1) Somalia-Maasai edaphic grassland; 2) Somalia-Maasai woodland; 3) *Acacia-Commiphora* deciduous shrubland; 4) *Acacia-Commiphora* deciduous bushland and thicket; 5) wetlands; and 6) salt flats (Herlocker and Dirschl 1972; Tanaka 1969; Schultz 1967; White 1983; field observations 1992-1993; Figure 4-8). It is important to note that the six vegetation types identified here serve only for descriptive purposes. Sharp natural boundaries between types do not exist. Instead, vegetation types overlap, forming a semi-arid vegetational continuum.

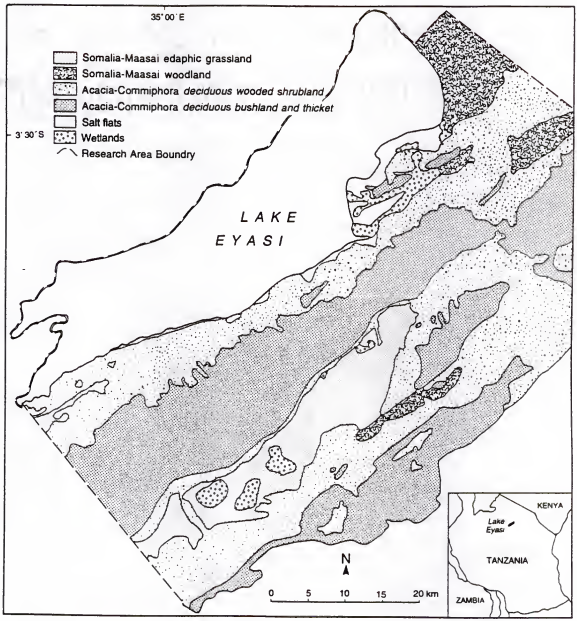


Figure 4-8: Vegetation Types of the Eyasi Basin. (Adapted from Tanaka 1969; Schultz 1967).

Somalia-Maasai edaphic grassland. This is a grassland of essentially waterlogged clay soils. In this vegetation type, grasses dominate. The Swahili term for this vegetation type is *mbuga*. *Mbuga* is notable for black cotton soil that becomes a quagmire in the rainy season (Lind and Morrison 1974). In the dry season, it is an important grazing area. The Somalia-Maasai edaphic grassland vegetation type is largely found in the Yaeda-Endanyawishi Graben and to a small extent in the southwest Mang'ola Graben where the soil is black cotton (Figure 4-8). Where the edaphic grassland occurs, it is marked by unbroken grassy plains that are often sparsely covered by trees and shrubs. The dominant grass species are *Setaria incrassata* (syns. *holstii*) and *Themada triandra*. Occasional tree species include *Acacia kirkii, A. xanthrophloea* (fever tree, Swahili: *migunga maji*). *A. seyal* is found in the seasonally waterlogged areas. Trees and shrubs usually become leafless during the dry season and grasses become dry and brittle. The annual rainfall and evapotranspiration is 500-600 and 1,000 mm respectively (Schultz 1967; Figures 4-5, 4-6).

Somalia-Maasai woodland. This vegetation type is found in riverine systems, in the marshy areas surrounding natural springs, in low-lying swamps that are subject to flooding, and in uplands with permanent ground water such as the medium slopes of Mount Oldeani and Lemagrut, fringing the montane evergreen forests of the Ngorongoro Volcanic Highland (Figure 4-8). Within this semi-arid region, it comes as no surprise

that sources of either surface or ground water have a profound effect on the character of the vegetation as the moisture condition of the soils compensates for low rainfall and high potential evapotranspiration. In this vegetation type, heavy undergrowth grasses remain green most of the year, especially near the natural springs. Tall grass of the species *Sporabolus consimilis* is found in the northern and western sections of Lake Eyasi. Other grass species include *Themada trandra* and *Hyparrhenia* spp.

The commonest tree species include *Acacia tortilis, A. xanthoploea, A. nubicas, A. gerrardi* and *Commiphora madegascariensis*. *Acacia lahai* occur in the northern section, on the slopes of Lemagrut and Oldeani Mountains. These trees occur in varying combinations and densities. Often interspersed with large fig trees (*Ficus sycamorus*), these acacias and commiphoras grow densely, giving a woodland appearance. Borassus palms (*Hyphaene petersiana*, syn. *H. ventricosa*) also occur in this vegetation type. Notable stands of Borassus palms occur along the north eastern shore of the lake, from Gisimangedha to Mikocheni, where volcanic soils and a high water table are found.

Acacia-Commiphora deciduous wooded shrubland. The chief species of this vegetation type are *Acacia* and *Commiphora*, but there is a considerable presence of other shrub species as well. Extensive areas are without large woody plants, but bushes and small trees frequently have a scattered occurrence. This vegetation type is most extensively

developed in areas of shallow and extremely well-drained soils, especially in the Mang'ola Graben and on the low hillsides of the Yaeda-Endanyawishi Graben (Figure 4-8). Granitic inselberges are surrounded by a variety of trees and bush species throughout. *Acacia tortilis* and *A. spirocarpa*, the "umbrella acacia", predominate in these regions. Commiphora trees are mainly found in the southern parts of the Mang'ola Graben. Here and there baobab (*Adansonia digitata)* trees occur, although they dominate the Eyasi Basin along the plains, valley and graben edges, and on the hill slopes and tops. Scattered trees of cactus and succulent plants are well represented. These include *Euphorbia candelabrum*, *E. nyikae*, *E. tirucali*, *Sanseviera ehrenbergiana*, and others. Undergrowth is scarce, except for annual grasses during the rainy seasons. These are then heavily grazed, so that for much of the year the ground is bare between the trees, thickets, and shrubs. When the rains cease sometime during late April, the annual grasses dry and die, and the acacia, baobab, and thorny trees become leafless. Toward the end of the dry season, the shrubs and baobab trees exhibit a pre-rain flush of foliage. By late November or early December, short grasses and green foliage cover the spaces between the thorny shrubs and trees.

Acacia-Commiphora deciduous bushland and thicket. This vegetation type is the most extensive, covering 35% of the total area. It is found on the steep, rocky hillsides of the Kidero Horst and Siponga-Masiedha Hills where soils are thin,

weathered, and leached (Figure 4-8). Characteristically, it is a dense bushland and thicket, 3-5 meters tall with scattered emergent trees up to 15 meters. Locally it is impenetrable, forming thickets. The dominant acacias and some of the commiphoras are spinous and so impede progress except along game and cattle tracks. Most species are deciduous.

Evergreen tree bushes, however, occur along seasonal water courses, in gullies, and in rocky areas with moisture-thin layers of dark or black loam soils. The majority of the tree species are multiple-branched small bushy trees. The dominant species include *Acacia brevispica* (on shallow, stony soils), *Acacia tortilis, A. mellifera, Commiphora madagascariensis, C. merkeri, Grewia*, etc. Communities of dwarf succulents are also important in this vegetation type, especially species of *Euphorbia, Aloe*, and *Sansevieria*. Baobab (*Adansonia digitata*) trees are densely scattered throughout forming a baobab woodland type of vegetation, especially on the Kidero Horst slopes. A variety of annual grasses are distributed throughout this vegetation type.

Wetland. This vegetation type is found in lower Mbarai River where it empties its water into Lake Eyasi, in the Mbarai floodplain (Barazani-Kisiriri flat lands), along rivers in Yaeda Chini, and around the natural springs where water accumulates (Figure 4-8). Elephant grasses, reeds, ferns, and papyrus (*Cyperus papyrus*) dominate in areas with permanent fresh water. The alkaline marsh and grasslands

along the lakeshore are dominated by the grass *Diplachne fusca*.

Salt flats. This type of vegetation is found along lake shores where there is little or no vegetation (Figure 4-8). The accumulation of soda and salt of Lake Eyasi after evaporation prevents plant growth except for plant species (known as halophytes) that grow on saline soils. Scatters of *Tamarix* and "salt bushes" (*Suaeda*) occur near the mouths of natural spring streams. The inhabitants of the Eyasi Basin have named the salt flats *Jangwani* (desert).

Wild Food Resources

It is important to note that the composition, physiognomy, and quality of the vegetation described above have been and are being modified by a variety of human actions. Humans induce pressures to the vegetation through slash-and-burn agriculture, overgrazing, uncontrolled fires and the cutting of *Acacia* and *Commiphora* trees for building material and fuel (firewood and charcoal). Light woods with thorns are utilized for making wind-break enclosures and fences for cattle (cattle kraals or *bomas*). This usage has largely reduced the present vegetation during the past 60 years (personal communications with Hadzabe foragers 1992-1993). The major climatic factor that modifies the composition, physiognomy, and quality of vegetation in the Eyasi Basin is increasing aridity due to low annual rainfall. Such vegetation modifications make the task of reconstructing

ancient vegetation and resource availability from modern derivatives more difficult and uncertain. Nevertheless, this section examines the available and potential resources that exist today for varying types of subsistence. This analysis will provide an informed basis for studying past and present-day forager usage of the Eyasi Basin and its wild resources.

The vegetation types described previously provide a variety of wild food resources. My definition of "wild food resources" is quite broad, meaning non-domesticated resources including plants and animals and their products that are utilized by Hadzabe foragers (also see Bunn et al. 1988; Vincent 1985a, 1985b; Woodburn 1968).

Plant foods. Potential plant foods are based on a variety of sources such as scientific (Peters et al. 1992), ethnographic (Vincent 1985a, 1985b; Woodburn 1968), and personal inquiry. Edible plant foods of the Eyasi Basin can be divided into four major categories: 1) bush fruits; 2) tubers and roots; 3) fruits and nuts; and 4) gums and resins.

Bush fruits (single or multiple seeds) that are eaten by the Hadzabe foragers include: *Cordia gharaf* ("madabi"), *Cordia sinensis, Salvadora persica,* and *Dobera lorathifolia* ("miswaki"), *Grewia villosa,* and others. Fruit trees are patchly distributed across the entire landscape of the Eyasi Basin. Nonetheless, dense patches of fruit trees occur in the Mbarai riverine system, in particular at "Kambi ya Simba" or "Kambi ya Mkaa" in Mang'ola area, and further inland in the Siponga-Masiedha hill bottoms, fringes of the Yaeda-

Endanyawishi Graben, and the Udahya riverine system (Figure 4-5). When they ripen, bush fruits form the basis of Hadzabe diet for several weeks (see also Vincent 1985a; Chapter 5).

Tubers and plant roots utilized by the Hadzabe for food include: //ekwaa (*Vigna frutescens*), matukwaiyuko (*Coccinea aurantiaca*), apanjuku, (*Ipomea*) //xamu, shumuko (*Vatovaea pseudolablab*), penzepenze (*Vigna sps.*), //qhatanabe, and others (Vincent 1985b). Most, if not all tubers and plant roots of the Eyasi Basin are perennial climbers (Vincent 1985a). They are found in all the described vegetation types except in the salt-flats and marshlands and the Somalia-Maasai edaphic grassland. Dense patches of edible tubers and plant roots occur on the basement hillsides of the Siponga-Masiedha and Kidero Horst in the *Acacia-Commiphora* deciduous bushland and thicket, on the weathered lava hillsides of Lemagrut and Oldeani, and the Mbarai River floodplain, in the Somalia-Maasai woodland, and in the *Acacia-Commiphora* deciduous shrubland along hillside deposits of weathered basement rocks.

The other plant food that forms a large part of the Hadzabe diet is baobab (*Adansonia digitata*) fruit and nuts (Chapter 5). Baobab trees are widely distributed across the Eyasi landscape except in the barren and swamplands. Baobab trees form dense patches on the weathered basement rocks of the Kidero Horst and the Siponga-Masieadha Hills. Moreover, Hadzabe utilize the fruits of doum palms (*Hyphaene petersiana,* syn. *H. ventricosa*) that are located along the

northeastern shore of Lake Eyasi, from Gisimangedha to Mikocheni.

Gums and resins of several *Acacia* species and legumes also are commonly eaten as snacks by the Hadzabe. These are widely distributed on the slopes of the Kidero Horst and the Siponga-Masiedha Hills.

Animal foods. The Eyasi fauna resources consist of an assemblage of wildlife with differing habitat preferences and size. Animals can be classified into three size categories which have a bearing on meat content. Big-game animals with over 200 kg of meat include the elephant, giraffe, zebra, eland, and buffalo. Medium-sized animals with more than 40 kg of meat include the impala, springbok, Thomson's and Grant's gazelles, topi, wildebeest, oryx, warthog, and greater kudu. Small-sized animals providing less than 40 kg are baboons, dik dik, mongoose, hare, hyraxes, etc.

Big-game animals feed a large group of people and they are more preferred by Hadzabe hunters (Bunn et al. 1988; O'Connell et al. 1988). Some of the big-game and medium-sized animals are migratory, migrating to the area from the Serengeti during the wet season. Elephants once came to this area from Manyara. Many of the small and some of the medium-sized and big-games have restricted home ranges. Regrettably, little work has been done on the distribution of these animals. For example, baboons form a more predictable resource for the Hadzabe (see Chapter 5) as the troops roam repeatedly through their home ranges. In the Eyasi Basin,

baboon home ranges average about 10-15 km^2 and are fairly packed (personal observations). Troop size ranges from 50 to 100 individuals.

A number of reptilian species are supported by the Eyasi Basin vegetations. Some of these reptiles, such as snakes and tortoises, are utilized by the Hadzabe foragers. A variety of lizards were observed in the rocky terrains. The lizards also are a useful source of meat.

The vegetation supports a wide range of avian species. Birds are of value to Hadzabe foragers for their meat and eggs. Large birds, such as kori bustard (*Ardeotis kori*), ostrich (*Struthio camelus*), guinea fowls, and the secretary bird (*Sagittarius serpentarius*), are common in the Eyasi Basin. Ostrich eggshells are used by the Hadzabe as water containers. Large, migratory birds such as the crowned-crane (*Balearica regulorum*) and ducks (*Anatidae sps.*) were observed in December to January in the lower Mbarai riverine system. Honey guide birds play a major role in leading Hadzabe foragers to locations with bush honey. Marsh birds include the herons, egrets, ibises, and kingfishers.

I observed many Hadzabe adult hunters carrying wooden (no metal arrow head) non-poisonous arrows in addition to poisonous arrows. Children, when hunting, always carried wooden non-poisonous arrows. These wooden, non-poisonous arrows are used for shooting small animals, birds, and reptiles encountered during hunting of big and medium-sized game. When hunting of big and medium-sized game is

unsuccessful, hunters devote the rest of their time to hunting for small-sized game, birds, and reptiles.

The other resources these vegetation communities provide, besides plant and animal foods, are honey and insects. Insects, such as flying termites and grasshoppers, are eaten today and are rich in protein and fat. Honey is abundant during the wet season. It is seasonal but predictable availability makes this resource significant as a reliable staple for Hadzabe foragers. Honey is highly esteemed and rich in carbohydrates. Honey made by small bees and insects is largely found in holes of acacia and other trees in the Kidero Horst and Siponga-Masiedha Hills. Honey made by large bees is found in holes of big trees (e.g., fig tree) in the Somalia-Maasai woodland type of vegetation.

Fishing is possible in Lake Eyasi beginning in late March after heavy rains fill up the lake. Occasional fishing is also possible in the streams and marshes formed by the natural springs. At present, there are neither data on the fish biomass in the Eyasi Basin nor information on the exploitation of fish by the Hadzabe foragers. However, we observed rock paintings of fish at two rock shelters, suggesting that fish may have been utilized in prehistoric times. Nevertheless, to date no fishing implements have been recovered from the archaeological record of the Eyasi Basin. I hypothesize that prehistoric foragers in the Eyasi Basin did not need fishing gear, as fish were easily caught by hand during the early dry season when Lake Eyasi started to dry

up. In September 1993, four months after Lake Eyasi had dried up, we counted 100 dry fish in a 0.25 km^2 area. This is a very low number as in September scavengers such as birds and others had scavenged many of the suffocated fish.

The diversity, quality, and seasonal availability of wild foods in the Eyasi Basin vary in a predictable manner. Nonetheless, the temporal and spatial distributions of wild food resources may best be seen as "patches" of resources in the midst of fairly continuous semi-arid vegetation types (Figure 4-8). This distribution of food and raw materials has a profound impact on the land-use and subsistence patterns of the Hadzabe. In Chapter 5, I focus on understanding Hadzabe forager land-use behavior in responding to dietary and other ecological challenges.

Despite limitations in carrying capacity, the present assortment of flora and fauna is sufficient to have supported a forager population prior to interference by non-forager communities. A considerable human migration into the Eyasi Basin occurred during the past century (McDowell 1988; Obst 1912; Woodburn 1964, 1988; personal communication with Hadzabe 1992-1993). Not only have these new residents reduced the natural habitats of animals and plant food resources by overgrazing and clearing land for agriculture, building materials, and fuel, but also they have killed many wild animals for food, protection, and trophies.

A year before my visit, hippos from the marshy area of Gisimangedha natural springs moved out into the Mbarai

riverine system during the rainy season. They eventually had to be killed as they were destroying irrigated agricultural plots. In the northeastern part of the Eyasi Basin, many large animals are now only memories. As will be observed in Chapter 5, the killing of animals, particularly commercial hunting in the Eyasi Basin, has negatively affected the Hadzabe forager way of life. Nevertheless, the availability of modern wild food resources suggests that the past carrying capacity of the Eyasi Basin was sufficient to support prehistoric forager societies within the circumscribed area under study.

Culture-Stratigraphic Framework

As noted in Chapters 1 and 9, the existing culture-history of the Eyasi Basin forms an important basis for analyzing the surface findings of this research. In this section, a more detailed summary of the culture-history, as established by Mehlman (1989), is provided.

The existing culture-history of the Eyasi Basin has been defined primarily from two sites: Skull Site and Mumba rock shelter. In the following sections, I summarize the lithic assemblages and other archaeological material from these two sites.

Skull Site

This is an open-air site located at 3°32'26" S and 35°16'05" E along the northeastern shore of Lake Eyasi, and

1021 meters a. s. l. (Mehlman 1989; Figure 7-1). In the 1930s, Kohl-Larsen and his team found fossil hominid remains of three individuals (Eyasi I, II, and III) on the surface (Reck and Kohl-Larsen 1936; Leakey 1936 cited in Mehlman 1989), now attributed to "archaic" *Homo sapiens* (Bräeur 1989).

In 1977 and 1981, Mehlman collected unabraded surface artifacts from the Skull Site. This surface sample documents radial flaking of cores to yield large, plain, and simple faceted, but, rarely Levallois flakes. Core scrapers and bifacially modified flakes are the most common retouched implements, apart from flake scrapers. Neither core-axes nor retouched points were recovered. Lavas and perhaps quartz are the primary raw materials for this lithic assemblage. Mehlman calls this assemblage the "Njarasan" Industry. Highly mineralized bones and teeth of animals and fish were found associated with the lithic artifacts. As noted in the previous section on past environments, at least seven of the Eyasi Beds faunal species are extinct (Mehlman 1989).

Previous stratigraphic studies (Rafalski et al. 1978 cited in Mehlman 1989) and that of Mehlman show that the "Njarasan" artifacts eroded from the middle part of Lake Eyasi's shore beds known as the Eyasi Beds. Two absolute dates available for the Eyasi Beds are on bone. A fragment of Eyasi II cranium calibrates to 34,000 BP and a piece of Eyasi I cranium to 35,000 BP (Protsch 1981 cited in Mehlman 1989). These two dates are considerably too young to be

accurate for the lithic artifacts and the associated faunal remains, some of which are extinct (Mehlman 1989). Dating of the Skull Site by uranium-series analysis has not been successful. On the basis of the stratigraphy and taxonomic considerations, a Middle Pleistocene age (about 200,000 BP) is inferred for the Eyasi crania, the "Njarasan" Industry, and the associated faunal remains (Mehlman 1989).

Mumba Rock Shelter

Mumba is a large rock shelter that is hosted by the banded and deformed gneisses of the Lag'hangareri-Ishimijega Hills. The shelter is parallel to the Lake Eyasi shore-line and sits about 3.5 km east of the modern lake shore (Figure 7-1). Although the Lag'hangareri-Ishimijega hosting block is well uplifted, Mumba shelter dips to the east at a very low angle of 30°. Accordingly, quarrying of the rock by wave action during high-stand lake levels and corrosion by salt water formed the shelter (see Chapter 5).

Mumba rock shelter was first test excavated by Ludwig and Margit Kohl-Larsen during their first anthropological expedition to Africa. It was later re-excavated by Margit Kohl-Larsen in 1938, revealing a deep archaeological sequence. However, only a cursory description of the findings appeared (Kohl-Larsen and Kohl-Larsen 1938, 1958). In 1977 and 1981 Mehlman re-excavated Mumba and studied previous Mumba material collected by the Kohl-Larsen's (Mehlman 1979, 1989).

In Bed VI-B (below 6.8 meters) of the Mumba deposits Mehlman recovered lithic material that he named the "Sanzako" Industry. Mehlman describes this assemblage as early MSA, characterized by high frequencies of side and notched/concave scrapers, bifacially modified pieces, and heavy-duty tools such as small bifaces and choppers. The ratio of Levallois technology and the frequency of retouched tools (points/percoirs) is very low. Although rare, true points are relatively large, broad, and irregular. Sundry scrapers account for more than one half of all scrapers. Amorphous cores predominate. About 95% of the lithic artifacts are made from quartz. Other raw materials include quartzite, nephelinite, chert, and obsidian. The raw material for the obsidian artifacts is believed to have come from as far as Lake Naivasha (320 km NNE of Eyasi) in Kenya (Merrick and Brown 1984).

Three hominid molars attributed to anatomically-modern *Homo sapiens* (Brauer and Mehlman 1988) were also recovered from Bed VI-B. The faunal remains of Bed VI-B are of modern animals, many of which can be found in the Eyasi Basin today. These include warthog, buffalo, oryx, wildebeest, and possibly two species of zebra. A uranium-series age of 131,000 BP has been obtained from the apatite of bone fragments recovered in this level (Mehlman 1989). This date, however, is inconclusive as bone apatite is known to give unreliable results.

In Bed VI-A at Mumba, Mehlman identifies the "Kisele" Industry, a local manifestation of MSA *sensu stricto*. This local MSA variant is characterized by a high frequency of disc and part-peripheral cores, with radial and Levallois cores occurring in lower frequency. Bifacial and unifacial points are the most distinctive implements forming about 10% of retouched tools. Convex end scrapers are the most common type of scrapers. Backed tools are few and atypical and burins are rare. Heavy-duty tool and bifacially modified tools are also present. Quartz is the predominant raw material. Other raw materials include quartzite, chert, obsidian, nephelinite, and basalt. The faunal remains associated with the "Kisele" Industry are also of modern species. These include hippopotamus, waterbuck, buffalo, crocodile, and two species of zebra. The "Kisele" Industry at Nasera Rock Shelter is dated to 56,000 BP by uranium-series on a rhinoceros tooth fragment. Based on an ostrich eggshell ^{14}C date of 27,000 BP from 2.2 m below datum and a deposition rate of 1 m per 13,000 ± 500 years, Mehlman arrived at an age of about 90,000 BP for the "Kisele" Industry at Mumba.

In Bed V Mehlman recovered a MSA/LSA transition industry that he named the "Mumba" Industry. Backed artifacts are the most frequent tool types followed by small convex, sundry side, and sundry end scrapers. Also represented are retouched points. Composite and bifacially modified tools are infrequent. Radial, platform, and peripheral cores are

infrequent. Bipolar cores form 75% of all cores. Mehlman's definition of this industry is largely based on the Kohl-Larsen's collection and on a small sample from his excavation. Since the Kohl-Larsens collection is seriously biased (Mehlman 1989), Mehlman's sample is too small to accurately define the "Mumba" Industry as a MSA/LSA transitional industry (Marean 1990).

Moreover, Bed V yielded a moderate frequency of ostrich eggshell fragments, beads, and shaped blanks. The Mumba Bed V faunal remains contain no extinct forms. The most common species represented include zebra, warthog, greater kudu, wildebeest, eland, Grant's gazelle, buffalo, oryx, impala, and possibly rhinoceros and waterbuck (Mehlman 1989). The diversity of fauna in Bed V deposits is in keeping with the 1930's accounts of the Eyasi Basin's fauna (Kohl-Larsen 1958, cited in Mehlamn 1989). Also found in Bed V are many remains of tortoise and land snail shells. The age of Bed V is problematic, but it is believed to be > 30,000 BP (Mehlman 1989).

Mehlman identifies another MSA/LSA intermediate industry in the lower Bed III at Mumba. This intermediate industry also exist in levels 6 and 7 at Nasera Rock Shelter. It has been named the "Nasera" Industry. In this latest intermediate phase at Mumba, points and backed microliths are equally rare. The "Nasera" Industry is dominated by scrapers, particularly small convex and convex end scrapers. Quartz form 97% of the total artifacts. A large quantity of

ostrich eggshell beads, shaped blanks, drilled pieces, and unfinished beads occur in association with the "Nasera" Industry. Also found in this level are bored stone balls and human skeletal remains known as the Mumba skeleton X. At Mumba, the "Nasera" Industry is associated with a ^{14}C date of 27,000 BP on ostrich eggshell(Mehlman 1989). The faunal remains associated with the "Nasera" Industry are modern and indicative of the present day environment and habitats of the Eyasi Basin (Mehlman 1989).

A late Pleistocene LSA assemblage known as the "Lemuta" Industry that overlies the "Nasera" Industry at Nasera rock shelter is missing at Mumba. At Mumba, there appears to be a stratigraphic gap of occupation, perhaps between 21,000 and 12,000 BP (Marean 1990). At Nasera, the "Lemuta" Industry is characterized by medium-sized (length 30-20 mm) backed tools that are nearly equal in representation to scrapers. End scrapers and small convex scrapers dominate among the formal scraper types. At both sites the faunal remains are indicative of dry open savanna similar to what prevails in the area today.

A Holocene pre-ceramic LSA assemblage occurs in layer 3B at Nasera and has been named the "Silale" Industry. The "Silale" Industry shows a dramatic increase in the representation of backed pieces, small convex scrapers, and geometrics. Mehlman suggests a mid-Holocene age for the "Silale" Industry. A radiocarbon date of 7,000 BP on bone was obtained. Mumba Shelter also has a pre-ceramic LSA

assemblage in upper Bed III, namely the "Silale" Industry. However, as Marean notes, Mehlman's "Silale" Industry sample is too small to provide adequate definition, other than the observation that the assemblage is dominated by small convex and convex end scrapers.

The "Oldeani" Industry is a Holocene/Mesolithic ceramic LSA recovered in Bed III at Mumba. It is remarkable for its profusion of backed microliths. Geometrics range from lunates to deep demi-circles. Trapezes are well represented, although triangles are rare. The formal microlith average 20 ± 5.0 mm in length and 12.1 ± 2.9 mm in width. Scrapers are dominated by small convex type. Ostrich eggshell beads in various stages of manufacture are common. Some beads and pendants are made of snail or bivalve shell. Several of the pendants are pieced twice. Also found are drilled bone fragments. The "Oldeani" industry is associated with ceramics of the "Kansyore" pottery tradition. In Bed III several human burials were found. The faunal remains are of modern wild species. A radiocarbon date of ≥ 5,000 BP on charcoal was obtained for the "Oldeani" Industry at Mumba.

The "Ishimijega" Industry is a Pastoral Neolithic industry associated with Narosura pottery. In the Eyasi Basin, this industry has been defined from three extensive open-air sites (Jangwani I and II, and Matete) and shelter deposits at Mumba Bed II, Ishimijega, and Njarasa. The microlithic backed tools of the industry are composed of about 65% of micropercoirs/drill bits. Geometric implements

are very rare. Bipolar cores predominate. Also present are grinding stones such as pestle rubbers and lobed axes. Stone discs with pecked/ground peripheries are also present. Ostrich eggshell and snail shell beads and blanks are associated with the "Ishimijega" Industry. The faunal remains include both wild and domesticates such as cattle and ovicaprids. Nonetheless, domesticates predominate in the MNI count at a ratio that approaches 2:1. A radiocarbon date of ± 1,800- 2,500 BP on charcoal was obtained for the "Ishimijega" Industry in the Eyasi Basin.

Early and Later Iron Age pottery and slags were excavated in Bed I and II at Mumba. The Early Iron Age is associated with the "Lelesu" pottery tradition and dates to about 1,800 BP. The Late Iron Age pottery of the Eyasi Basin compares to those from Engaruka (Robertshaw 1986) which is thought to date between 450 and 250 BP. Stone cairns, possibly of Iron Age period, are distributed throughout the Eyasi Basin. Iron Age irrigation furrows, similar to those at Engaruka are found in the Endamaghay and Olpiro areas at the foots of Oldeani and Lemagrut Mountains (J. Sutton 1992, personal communication).

The Pastoral Neolithic and Iron Age evidence suggests that pastoralists, agriculturalists, and foragers have co-existed in the Eyasi Basin for the past 3,000- 2,000 BP (Mehlman 1989).

Socio-economic Adaptations of the Eyasi Inhabitants

In this section, I analyze the existing economies and adaptations of the present inhabitants of the Eyasi Basin. In particular, I focus on the interrelationships among human, biological, and physical resources, the products of these interactions, and their effects on human adaptation. The results of this analysis enriches our knowledge of current socio-economic conditions, and should provide a better empirical base for our understanding and analysis of local prehistoric human adaptations.

A mixture of four different economic activities occurs in the Eyasi Basin. Semi-mobile pastoralism, foraging, irrigation-cultivation, and rain-cultivation are the major faces of the adaptive economic strategies practiced by the Eyasi inhabitants. Semi-mobile pastoralism is being practiced by the Mang'ati people. Iraqwi agro-pastoralists possess a mixed economy of farming and pastoralism. Although the number of Mang'ati pastoralists is relatively small compared to Iraqwi agro-pastoralists, the Mang'ati herd a large number of cattle, goats, and sheep. Almost every semi-mobile pastoral and agro-pastoral household keeps donkeys and guard dogs as well. According to them, their dependence on animal husbandry arose from a combination of historical, ecological, cultural, and economic factors. Large herds of cattle, goats, and sheep serve as sources of social status and prestige. In addition, livestock is a source of milk and

meat and a guarantee against crop failures. Also, livestock is a medium of exchange and a means to pay bridewealth. During the rainy season, the livestock depend on locally available pasture. Since hardly any grazing remains in the area during the dry season, it is impossible to keep the livestock in one place. Therefore, frequent temporary movements of livestock are necessary, primarily toward the west and southeast as far as Mwanza and Shinyanga regions.

Chapter 5 will address the foraging socio-economy in greater detail. This mode of subsistence economy is practiced by the Hadzabe foragers. Irrigation farming as a form of human adaptation depends on natural springs as the main source of reliable water. Thus, these springs form the basis of human and domesticated animal life in the basin (Tanaka 1969; field observations). Traditional and modernized farming have relied heavily upon the natural availability of spring water to supply various gravity flow irrigation systems. Gasoline-powered pumps have in recent years aided in the irrigation systems. A large majority of irrigation farmers practice a single crop economy. Their most important crop is onions, the only cash crop of the area; they are cultivated throughout the year. An average farmer spends between eight and ten hours a day ploughing, transplanting, planting, harvesting, manuring, or pesticide spraying. During the past few years, maize has increasingly become an important rainy season crop. This change is probably due to the increasing unreliability of maize

production in Karatu and Mbulu. Other less important crops include beans, sweet potatoes, cassava, and sorghum, together with rice in the marshlands of Kisiriri and Barazani villages.

Rain is the main determining factor in successful crop production for rainfall cultivation. As Tanaka (1969) observed, practicing this type of farming in an arid landscape such as the Eyasi Basin is a tremendous gamble. Nevertheless, this economic adaptation is being undertaken in all areas of the Eyasi where the basement rocks are not cropping out. Due to the unreliability of the rains, the most important crops are sorghum, maize, beans, fingermillet, sunflower, and other drought resistant crops. The normally low yields are kept for local consumption, since there is rarely a surplus. In bad years, when the rainfall is too low even for subsistence, inhabitants buy their food supplies from the Karatu and Mbulu crop markets.

A few other minor economic adaptations practiced by the present-day inhabitants of the Eyasi are worthy of mention. Fishing is possible in Lake Eyasi beginning in late March after heavy rains fill up the lake. During this period, some people completely abandon other economic activities in favor of fishing. Raw fish is locally sold and dried fish is transported as far as Shinyanga and other parts of the Arusha region. Occasional fishing is also possible in the streams and marshes formed by the natural springs. In the Gordfani natural springs area, eight to ten individuals practiced

fishing during this study as their major socio-economic activity. The fish caught included tilapia, lungfish, catfish, and others. These were sold to people in the village. A German settler in Gisimangedha is using the available spring water to raise fish for domestic and commercial purposes.

The Eyasi Basin is highly endowed with attractive tourist resources. Visitors from across the globe come to see the lake, archaeological sites, natural springs, Hadzabe foragers, and the Mang'ati pastoralists. During our research, at least four or five tourist groups camped at the Gordfani's village camp sites each month. These tourists bring in income that revitalizes local communities and encourages further economic investment. Some individuals in the Eyasi are now living from their income as tour guides and tour operators. Nevertheless, although tourism has the potential of encouraging development in the Eyasi, it needs to be carefully planned so that it does not deplete the physical and cultural resources or degrade the fragile environment of the Eyasi Basin.

Regarding mining resources, the Eyasi Basin possesses very well developed pegmatite veins that cut through the gneisses. Sporadic veins of pegmatite material occur in the Gordfani, Gendargha, and other hills. The area also seems to be rich in non-metallic minerals (Pickering 1964; Tanaka 1969). Mica occurs associated with feldspar or quartz in the pegmatite. Also, we observed several quartz-mica-tourmaline

veins in these hills. A green tourmaline mining company started in 1992 at the Gordfani Hill and its vicinity, but mining has so far produced little. At Mount Jobaji, the Mang'ola prison is producing lime.

The hot, saline springs can also be of economic value (Harris 1981). Small quantities of salt are extracted locally from the lake during the dry season and plans are underway by the Department of Engineering of the University of Dar es Salaam to extract salt from the lake for commercial purposes.

A helpful pointer to finding productive economic directions for the Eyasi Basin is observing activities on market day. Market day is held in Gordfani once every month. Two or three days before market day the whole region is a rush of activity, either preparing produce for market or preparing themselves for a long walk to and from the market place. Many provisions, however, such as clothes, shoes, foodstuff, beer, local brews, soft drinks, etc., are brought by traders from Karatu and other areas. Up to twenty trucks will bring people and products from Karatu to the market place. Pastoralists and agro-pastoralists from all over the region bring their cattle to the market for sale. Hadzabe foragers come to the market to sell their handicrafts (e.g., bow and arrows) and, more often, to buy necessary provisions and to feast. The commercial farmers do not bring their produce (onions) as this is sold to traders at the farms all year round. At the market, all social groups spend much of

their money on alcohol, food, and other merchandise that are sold by traders at high prices. Drinking may continue in different villages even after the market day by both men and women.

Market days are important not only to the regional economy. They also serve as social gatherings for all the different social and ethnic groups in the region, bringing together up to four hundred individuals. No work is possible in the surrounding villages on a market day. Our base camp located at the major fresh water spring in Gordfani was about one kilometer from the market place. We used the opportunity to interact and conduct informal interviews with the Hadzabe foragers about their land-use systems of the Eyasi landscape (see Chapter 5).

Present-day Settlement Patterns in the Eyasi Basin

In arid environments, soil, rainfall, and the distribution and predictability of resources play important roles in determining settlement patterns of people with different socio-economic adaptations. Take agriculture, for example. To support cultivation in a semi-desert landscape like the Eyasi Basin, soil should not only provide the necessary nutrients, but should also have adequate drainage. Consequently, land favorable for settlement by agriculturists is limited and is confined largely to the northeastern and southwestern parts of the Basin. Here, natural springs provide water and the soils are rich and offer adequate

drainage. Where these critical resources (arable land and water) are available, agriculturists live in well organized villages (clustered settlement patterns). Where critical resources are scarce, they live in isolated homesteads, especially further inland. In the Eyasi Basin, agriculturists practice a sedentary or nucleated settlement pattern.

Although the Yaeda-Endanyawishi basin has fertile soils, agriculture is not practiced because the clay soils have poor drainage. Also it is difficult to farm the wet clay soils. Instead, the Yaeda-Endanyawishi valley grasses form perfect grazing grounds for domesticated animals during the dry season. Semi-mobile pastoralists and agro-pastoralists, therefore, live in highly isolated homesteads on the fringes of the Yaeda-Endanyawishi basin along with other areas throughout the Eyasi landscape where critical resources for their cattle are available. Semi-mobile pastoralists and agro-pastoralists practice a transhumant movement system whereby they live in more or less permanent settlements during the wet seasons, but go out on grazing expeditions during the dry seasons.

The Hadzabe foragers (Chapter 5) live in temporary camps and rock shelters distributed throughout the Eyasi landscape. Their settlement pattern is, therefore, mobile or transient. As will be observed in Chapter 5, traditional and modern agriculture, tourism, and mining practices are increasingly impacting the Eyasi Basin, affecting present and future

forager and pastoral ways of life. Expanding agricultural, mining, and tourist activities are restricting the Hadzabe foragers to only small parts of their traditional land. This trend becomes particularly problematic, given that these small areas possess few of the resources necessary for their survival. In fact, these regions are dramatically dissimilar to the type of environment vital to Hadzabe traditional subsistence forms and adaptations.

Summary

This chapter has described the geology, geomorphology, and environments of the Eyasi Basin. These physical variables interacted to influence past human land-use, resource exploitation and eventual human adaptations of the Eyasi Basin. Furthermore, the chapter has examined the economic factors that govern current land-use and human adaptations in the Eyasi Basin. As observed above, the present economy of the region consists of the activities of foragers, pastoralists, agro-pastoralists, agriculturists, and traders. Land-use patterns are sedentary for the agriculturists, semi-sedentary for the pastoralists and agro-pastoralists, and mobile for the foragers.

From the data presented in this chapter and Chapter 5, three relevant conclusions are reached. First, some aspects of contemporary socio-economic adaptation in the Eyasi Basin were also important in the past and may be worthy of investigating archaeologically. In particular, the present

forager usage of the Eyasi Basin can provide a base to build testable models for explaining prehistoric forager landscape usage (Chapter 5).

Second, the trends of geologic, volcanic, and geomorphologic structures show that there have been no significant changes in the structural makeup of the Eyasi landscape over the last 200,000 BP. The last tectonic and volcanic activities to affect the structural makeup of the landscape took place 400,000 BP. I infer that the geomorphological effects of the Eyasi landscape structure on forager's mobility patterns has been relatively stable through time since 400,000 BP.

Third, although there have been some climatic changes in the Eyasi Basin as indicated by sedimentary data, the faunal remains from Mehlman's (1989) study suggests that environmental conditions and habitats similar to the present-day were in place during the late Middle Pleistocene. I presume that the climatic and environmental changes as evidenced by the sedimentary data were not sufficient to adversely affect the distributions of flora and fauna (including hominids). Therefore, present-day environments and habitats in the Eyasi Basin may be assumed to broadly represent those in which foragers of the past 200,000 BP subsisted.

The above conclusions are particularly important to the primary goal of this study, i.e., to understand the cultural use of the landscape during the late Middle Pleistocene to

early Holocene. Since physical factors have remained relatively stable from the time of early hominid occupation, it can reasonably be argued that variations in hominid land-use patterns and foraging behaviors in the Eyasi Basin will be due to cultural factors.

CHAPTER 5
ARCHAEOLOGICAL IMPLICATIONS OF HADZABE FORAGER LAND-USE AND RESOURCE UTILIZATION IN THE EYASI BASIN

Introduction

The nature of archaeological research has changed substantially within the last decade or two. Ethnographic studies of forager land-use and resource utilization, especially those that pertain to activities conducted away from perennial habitations (e.g., Binford 1980; Hitchcock 1982; Yellen 1977), have stimulated archaeologists to explore the interpretive potential of the full range of archaeological remains, including surface and low density artifact scatters. Contemporary forager land-use continues to be an important element of archaeological investigation in the 1990s (e.g., Gamble and Boismier 1991).

The study of contemporary forager land-use and resource utilization provides a viable approach to understanding Late Quaternary forager usage of landscapes and the spatial patterning of the archaeological record. In this chapter, I present the results of Hadzabe forager land-use and resource utilization patterns in the Eyasi Basin. My major concern in studying the Hadzabe foragers was to attempt to understand their spatial use of the broad landscape and its resources.

Understanding these large scale spatial factors is an important means of reconstructing prehistoric foragers' adaptive strategies. Since the spatial patterning of the archaeological record carries behavioral implications of past human activities, only the use of spatial data at the landscape scale can provide resolutions relevant for the investigations of such patterning.

In this chapter, I consider the ways in which several factors interact to structure Hadzabe mobility patterns. The major goal is to use the Hadzabe results to generate testable hypotheses and to develop theoretically and soundly empirically grounded expectations about the behavioral activities related to land-use and resource utilization patterns of MSA and LSA foragers in the Basin. Aspects of how the Hadzabe use their landscape and how this can be related to the archaeological record of the Eyasi Basin have not received sufficient attention by previous researchers. This approach provides a useful basis for evaluating the behavioral aspects of the spatial nature of the archaeological record in the Basin.

Hadzabe Forager Society

The forager society known today as the Hadzabe is variously referred to in the literature as "Tindiga", "Kangeju", "Kindiga", "Hadzapi" or "Hadza". The name "Hadza" is relatively recent in anthropological literature and refers to the name the people call themselves, meaning "person"

("Hadzabe" is the plural). Their language is "Hadzapi". According to our informants, the names Tindiga, Kindiga, and Kangeju are nicknames derived from the Bantu languages in the region referring to the Bantu tribesmen who fled colonial aggression and taxes to live with Hadzabe in the bush. Through time, the name "Tindiga" has been used to refer to all the people that live in the bush dependent on hunting and gathering. To the Hadzabe, the names are derogatory; the connotation is a people who, due to laziness, escaped work in the villages by fleeing to the bush (see also Ndagala 1988). Nonetheless, the name "Tindiga" is still used by non-forager societies in the Eyasi Basin to refer to the Hadzabe.

Although for a long time the Hadzabe have been in contact with other ethnic and cultural groups in the Basin through trade, government settlement schemes, intermarriage, labor and other socio-economic activities, they still maintain a distinct ethnic and cultural identity of their own. As far as language, political and social structures, customs and economy are concerned, they have little in common with their neighbors. Nonetheless, some aspects of Hadzabe lifeways and cultural identity are changing as Hadzabe are becoming more and more exposed to interaction with their neighbors and other world outlooks.

An exact estimation of Hadzabe population density is a difficult undertaking. Their nomadic lifestyle in a vast landscape, the fluid nature of their camps, and their habit of changing names have led to either omissions or over-

inclusions (see also Blurton Jones et al. 1992). Early estimates put the Hadzabe at 400 or so individuals (Woodburn 1972). Recent demographic studies estimate the Hadzabe population to be about 600-800 (Blurton Jones et al. 1992; Bunn et al. 1988; O'Connell et al. 1988), and between 1,500 and 3,000 individuals (Kaare 1989; PMFPO 1992; Ndagala and Zengu 1989).

Traditionally, the Hadzabe are mobile, egalitarian, immediate-return foragers. In recent years, however, the government of Tanzania has launched comprehensive development programs to settle them in permanent villages. These government settlement schemes lure the Hadzabe by providing them with free education and health services, bee keeping and agricultural inputs (PMFPO 1992). At present, approximately one-fourth of the total Hadzabe population continues to practice a full time traditional hunting and gathering lifestyle (Bunn et al. 1988; O'Connell et al. 1988). The rest, through the established government settlement schemes, have been semi-settled in Endamaghy, Munguli, Mwangeza, Yaeda Chini and Mungo-wa-Mono villages in Mbulu district. Hadzabe stay at these villages only when food assistance from the government is available. Sometimes, Hadzabe abandon these villages even if the food supply from the government is available. The semi-settled Hadzabe groups practice a combination of part-time traditional foraging and other production activities.

Although Hadzabe society can be said to be homogeneous in terms of language, social organization and lifeways, they prefer to identify themselves according to areas of origin (birth) (Woodburn 1968). Therefore, they identify themselves as people of Mang'ola (*Mang'olanebe*), people of Siponga (*Siponganebe*), people of the rocks (*Harianebe*), and people of the west (*Tli'kanebe*). Nevertheless, this does not mean that they live exclusively in these areas; rather, they are areas where certain Hadzabe groups were born or prefer to live.

Aspects of Research on the Hadzabe

Since the turn of the last century, Hadzabe foragers have repeatedly attracted the attention of missionaries, early explorers, government administrators, sociologists, linguists, anthropologists, medical doctors, and more recently archaeologists and human ecologists. The reasons for studying the Hadzabe have been many and varied.

Hadzabe social organization, economy, and ecology have been outlined by Woodburn (1968, 1972, 1980) and others (e.g., Kohl-Larsen 1958). Biomedical studies of the Hadzabe have been undertaken as collaborative efforts between medical doctors and physical and cultural anthropologists (Barnicot et al. 1972; Bennet et al. 1973). Studies, policies, and projects aimed at transforming the Hadzabe from a mobile and foraging lifestyle to permanent settlements and farming have been the focus of the government, early missionaries, and international development planners since colonial times (see

Kaare 1989, 1993; Ndagala 1988; PMFPO 1990, 1992). Anthropological research within the last decade has been primarily concerned with subsistence studies, especially plant foods and their overall contributions to the Hadzabe diet (Vincent 1985a, 1985b). Others have focused on Hadzabe perceptions of their past and their origin (Ndagala and Zengu 1989).

More recent researches have focused on human ecology and demography (Blurton Jones et al. 1992, 1993) and the factors (ecological, nutritional, and behavioral) that underlie bone-accumulating activities of the Hadzabe hunter-gatherers (Bunn et al. 1988; Hawkes et al. 1991; O'Connell et al. 1988). Archaeologists have come to realize that certain behavioral aspects of Hadzabe hunting and scavenging, carcass processing (e.g., butchering, transport), consumption, and bone disposal are relevant to the interpretation of the subsistence strategies and sociological behavioral patterns of early hominids. The Hadzabe hunting, scavenging and carcass processing behavioral data and the archaeological consequences thereof have been used either to formulate or test propositions about the characteristics of early hominid behavior in Eastern Africa.

How the Hadzabe use their landscape and how this can be related to the organization of the archaeological record of foragers in the Eyasi Basin has not received sufficient attention by previous researchers. Woodburn (1972) has examined Hadzabe residential alignments in relation to the

economy and social organization at the scale of the camp ("site"). My study differs from Woodburn's in that it examines Hadzabe land-use and resource exploitation in relation to various elements of the ecology and culture at a broad landscape scale. My major interest was to understand how these elements can influence Hadzabe land-use and resource exploitation both at the individual and group (community) levels. My approach has been a processual one in which land-use and resource exploitation patterns are causally linked to elements of the landscape and to aspects of Hadzabe culture and economy.

Consequently, during my archaeological landscape survey in the Eyasi Basin, an attempt was made to seek information concerning questions on broad issues related to Hadzabe forager land-use and resource exploitation patterns. Why, when, and how do the Hadzabe move across the landscape? Who is involved in the movement? How do Hadzabe perceive their landscape and its resources? What is the Hadzabe sense of the past in terms of attachment to places and things found on the landscape?

The premise in selecting the Hadzabe for this study was based on the assumption that the varied physical and cultural factors that influence present-day Hadzabe movement across the landscape may have acted in a similar way in influencing MSA and LSA foragers in the Eyasi Basin. The later approach was aimed at collecting extant data that can provide an opportunity to generate testable hypotheses and to develop

theoretically and empirically better grounded expectations about the behavioral activities, land-use, and resource utilization patterns of prehistoric foragers in the Eyasi Basin.

Factors Influencing Hadzabe Mobility

This study identified three major factors that influence Hadzabe usage of the Eyasi Basin landscape: ecological, cultural, and economic (Figure 5-1).

Ecological Factors

Hadzabe response to the spatial and temporal distribution of food resources. Most if not all the studies concerning spatial land-use patterns of mobile people acknowledge that movements by mobile groups are influenced by the spatial distribution of resources. Studies of the Hadzabe diet have shown that vegetable foods provide more of the resource base than mammal meat (Vincent 1985a, b). As previously noted, the Eyasi Basin is a semi-arid region with scarce to sufficient exploitable resources that are distributed in patches across the landscape. Water, plant and animal foods are present in various habitats, and the differential availability of these resources is partly due to seasonal changes. Recent research has shown that Hadzabe mobile land-use patterns are in response to a seasonally variable, patchy distribution of scarce to sufficient resources (Bunn et al. 1988; O'Connell et al. 1988). This

study suggests this also. According to our respondents (all interviewee) and informants, the response to the seasonally variable, patchy distribution of scarce to sufficient resources is one among many other factors that influence Hadzabe land-use in the Eyasi landscape.

Presence of obnoxious or disease carrying insects at base camps. When obnoxious disease carrying insects such as lice, fleas, mosquitoes, etc., multiply due to accumulating garbage and human feces at or near Hadzabe camps, the Hadzabe abandon the base camp and move to another place (also see Woodburn 1972).

Hadzabe search for safe refuge. Strong weather presents significant risks to Hadzabe foragers. Heavy rainfall may penetrate grass-thatched huts, and strong whirl winds may destroy Hadzabe base camps. In response, Hadzabe move to rock shelters or other sheltered locations (also see Woodburn 1972). During the wet seasons, the number of predators such as lions increases in the Eyasi Basin. Because of their relatively elevated positions, rock shelters are preferred by the Hadzabe because of the security they offer against predators. They also warm and comfortable during the wet seasons.

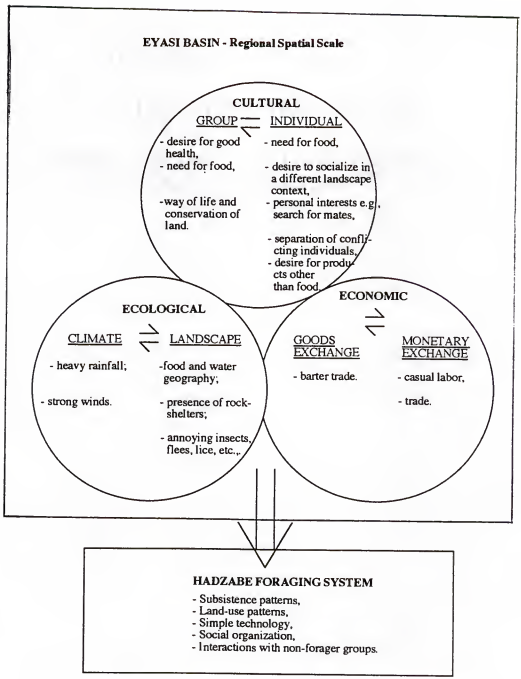


Figure 5-1: Factors Interrelated to the Hadzabe Foraging System.

Cultural Factors

Clearly, ecological conditions influence Hadzabe land-use patterns, but which cultural factors impinge on decisions determining when, where and how to move? More importantly, what is the relative influence of these factors at both the group and individual levels? To date, this study and that of Woodburn (1972) have identified a few of these influences:

Hadzabe move constantly across the landscape because it is their historical and cultural habit. According to the Hadzabe, an area with rich and predictable exploitable food resources can be abandoned in favor of another with patchy resources just because they are tired of staying in one particular location. This explanation, however, is unsatisfactory, especially since some of the movements involve only a short distance that cannot make much meaningful difference in terms of location or access to food (also see Woodburn 1972). My observations suggest that Hadzabe movements have decided effects on the landscape, including ensuring that their activities have minimal impact on their surroundings. The Hadzabe consider themselves to be people of the bush. They view the landscape as the provider of their needed food resources and shelters. As a result, they generally value and conserve their landscape and it's resources, and are wise in land-use planning. Short periods of occupation at various locations ensure that their activities have minimal impact on the landscape. Further,

the activities of the Hadzabe could have an impact on their health were they to stay in one place for unduly long. Accumulating camp garbage can attract disease carrying flies.

Hadzabe search for preferred, rare, and highly ranked nutritional food items (see also Woodburn 1972). An area with rich and predictable food resources can be deserted in favor of another with sparse, but culturally and nutritionally preferred resources. Once the preferred resources diminish, the group can return to the place with plenty but less preferred food. The preferred and highly ranked resources include honey and meat. Bunn et al. (1988) and O'Connell et al. (1988) have noted Hadzabe hunters abandoning completely their hunting missions in favor of honey exploitation.

Hadzabe search for highly desired non-food items. These may include stones for making tobacco pipes and trade goods such as tobacco, spear heads, clothes, shoes, and other items. Trade goods are usually obtained in Mang'ola on a market days. Hadzabe attend market days in Mang'ola and other areas to purchase these products.

Hadzabe desire to socialize in a context away from a habitation location. Market days are not only selling, buying, and trade days, but also social gathering days bringing together different social groups in the Eyasi Basin. Hadzabe from the Masiedha-Siponga area, Mang'ola, and other areas attend the market days to socialize, feast, and scavenge. The desire to socialize in a context away from a

habitation location is not limited to a market day, but also during other days when Hadzabe from one camp visit another camp. Mate search and conflict avoidance also cause individuals to move away from base camp.

Hadzabe desire for good health. Hadzabe move out when death, terrifying nightmares, or sickness happens in a habitation location (see Woodburn 1972). Hadzabe link sickness with the locations in which they occur; the best way to avoid sickness is to move away. Good health is seen as an attribute of regular frequent movement and failure to do so leads to illness (Woodburn 1972).

Economic Factors Other than Subsistence

The need for money to buy commodities. This has led some Hadzabe to seek casual labor in neighboring villages. During our eight month stay in the area, it was common to see Hadzabe individuals in Mang'ola seeking casual labor a few days before the market day. This tendency influences Hadzabe mobility patterns, especially at the individual level.

The desire to trade with neighboring groups. The need for money to buy commodities also has led Hadzabe men to sell some of their material culture, particularly bows and arrows, to tourists in Mang'ola and to other local people. The desire to trade with neighboring groups influences individual Hadzabe mobility patterns.

The practice of barter trade. Hadzabe participate in a network of exchanges with non-forager groups in the Eyasi Basin. Hadzabe exchange goods include game meat, honey, and traditional medicines. In return the Hadzabe can receive money, ready made arrow heads, tobacco, or other needed commodities. These exchanges necessitate Hadzabe movements and express social links between themselves and others.

Hadzabe Utilization of Rock Shelters

The large numbers of rock shelters is a feature of the Eyasi Basin. The majority of these shelters are structurally controlled, free-standing rock slabs resulting from faulting. Most are found in high-lying basement hills of the Precambrian period. Here, the rock shelters gently dip to the east at an angle of about 40° with some local variations of about 5°.

After the uplifting episodes (see Chapter 4), one side of an uplifted block remained laterally uplifted as a vertical or hanging block (Figure 5-2). These uplifted hanging blocks were later affected by two erosional processes: exfoliation and wave actions. In the inland, exfoliation modified the western sides of the hanging blocks creating considerable overhangs. This is why the majority of rock shelters have an opening with a westerly orientation.

Along the eastern shore of Lake Eyasi, quarrying of the uplifted blocks by wave action and corrosion or chemical weathering by salt water created shelters and caves. This is

demonstrated by Mumba rock shelter. The host block is parallel to the shore line with a striking angle of 350° NNW. The shelter dips east at a low angle of 30°. At this angle, the overhang must have been too low for a shelter. Obviously, wave-actions during periods of high lake levels cut-off the lower part of the hanging block, creating a shelter. Hence, faulting is the major force behind rock shelter formation in the Eyasi Basin.

The studied rock shelter floors vary in size from 13 to 218 m^2. They possess a range of aspects, but the majority have an opening with a westerly orientation (Figure 5-3). This relates to the overall westerly orientation of the escarpments.

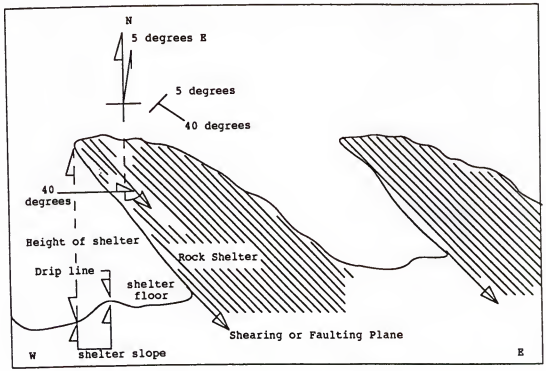


Figure 5-2: An Example of an Uplifted Overhang Rock Shelter.

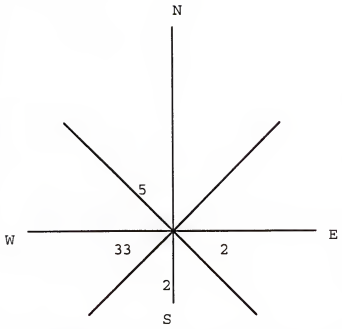


Figure 5-3: Aspects of the Studied Rock Shelters.

Hadzabe call these large gneissic rock shelters *nyumba*, a Swahili word for house given to them by god. Some extractive activities such as processing food takes place in the shelters. Remains of baobab fruit bark and seeds, cereals (e.g., corn, millet, etc.), and animal bones were found on the floors of six rock shelters. Moreover, craft works such as bead stringing by women, shaving arrow shafts, and hafting feathers to arrow shafts by men takes place in rock shelters. Beads, bird feathers, wooden arrow shafts, fire sticks, wooden spoons, and wood shaving remains were found on many rock shelter floors. The spatial distribution of these items of Hadzabe activities suggest gender differences in the use of shelter space. Evidently, female activities are different from that of male's. Unfortunately, the spatial distribution of gender activities in rock

shelters was not investigated further due to time constraints. Undoubtedly, studies of gender use of space in rock shelters by Hadzabe foragers will prove interesting avenues of research in the future.

In the occupied rock shelters, we observed food debris and items of Hadzabe material culture discarded around activity areas. Two dominant discard patterns were noted. One is within the rock shelter; the other is to discard food debris and other material outside the dripline, particularly at the slope. Most material, however, is located immediately outside the dripline (Figure 8-11). We also observed prehistoric lithic materials on shelter floors and on the slope of many rock shelters we studied. It is interesting to ask in this context whether the Hadzabe discard patterns of food debris and material culture, and the usage of the rock shelters, may provide appropriate inferences for prehistoric foragers.

Five of the nineteen shelter floors with evidence of recent utilization had been modified. Three had simple thorn fence structures at the dripline (e.g., Figure 8-8, 8-11). The function of these structures as described by Hadzabe informants (one of them was the main occupant of one of the shelters) is for protection against predators and wind. Discrete sleeping units defined by roughly circular frameworks of branches were recorded at two rock shelters, and ethnographic details concerning the social composition of shelter occupants are available for one shelter. This latter

rock shelter (Qhadenaqwete 3; Figure 8-11) was inhabited recently for about six months (December 1992-May 1993) during the wet to early dry seasons by a family composed of six individuals: father, mother, mother in-law, two daughters and a son. This shelter has a floor area of 47.4 m^2.

The four circular structures of branches represented four fenced sleeping units: father and mother (A), mother in-law (B), daughters (C), and son (D) (Figure 8-11). The unit for the couple was well fenced by tree branches to maintain privacy. The sleeping units were arranged in parallel and along the shelter wall, leaving a communal or working area in the center. The units are located about one meter apart. Each of the four sleeping units had a fire place or hearth located at the entrance (Figure 8-11). Apart from cooking and roasting of food, the fires also are used to keep the shelter warm and to keep predators away during the night. The placement and spatial distribution of hearths in rock shelters much like those of the Hadzabe foragers have been found in European UP and at Big Elephant LSA site in Namibia (Clark and Walton 1962; Movius 1977).

At another rock shelter we found wooden pegs for suspending arrows pitched into the shelter's floor. According to our informants, arrows have to be placed on these wooden pegs when not in use so that the poison on the arrow heads cannot be rendered weak by ground moisture. Menstruating women are not allowed to touch the poisonous arrows, as they also can render them weak. In fact, married

Hadzabe hunters do not hunt during the whole period their wives are menstruating as a menstruating wife is believed to bring bad luck in hunting. Unfortunately, such wooden pegs will rarely be preserved in the archaeological record.

We had an opportunity to observe a Hadzabe forager, namely Matina and his friend, living in a shelter from December 30, 1992 to January 2, 1993 while excavating Gordfani 2. Before excavating this shelter, we found fire sticks, a wooden spoon, a hide finger ring, arrow shaft fragment, rusted metal, broken tobacco pipe, peas, and remains of "magadi" soda (locally used as salt) on the floor. Moreover, we observed a metal pot, a calabash, and a goat hide that were left in the shelter. According to Matina, Gordfani 2 belongs to him and he occupies it during the wet season.

When Matina and his friend moved in during the rainy season of 1993, they brought with them a large bowl full of *Cordia gharaf* and *Salvadora persica* berries. These were consumed by the two men in two days. On the third day of our observation, Matina and Nangai caught a big tortoise 200 m from the shelter. This was brought to the shelter where it was killed and then roasted to remove the carapace. These activities took place on the slope of the shelter, beyond the drip line. After removing the carapace, the meat weighed about 7 kg. It was cut into pieces, cooked, and consumed at once by the two men in less than 20 minutes. The cooking and

consumption was done in the shelter; the bones were tossed off on the slope of the shelter beyond the drip line.

According to our informants, the criterion influencing the choice of a particular shelter are the size and degree of protection that the rock provides from rain, sun, wind, and predators. Also, elevated rock shelters enable one to survey the landscape, crucial for sighting game animals for hunting. I call the factors that influence Hadzabe choice of a particular shelter for occupation as the "physical attributes" of rock shelters. My study shows, however, that not all rock shelters with desirable physical attributes are occupied. This suggests that Hadzabe cultural preferences are also involved in selecting rock shelters for occupation. The cultural preferences that influence Hadzabe choices of rock shelters were not further investigated during my research due to time constraints. Nonetheless, I hypothesize that MSA and LSA foragers in the Eyasi Basin also were influenced by such choices since not all rock shelters with desirable physical attributes were painted or contained traces of past material culture.

About 45% of the observed rock shelters with evidence of recent use by Hadzabe have either rock paintings, archaeological deposits, or both. Although the Hadzabe no longer execute the technique of painting, they claim that their ancestors were responsible for the rock art and other archaeological phenomena in the Basin. Such claims were not further investigated during my research; nonetheless, Hadzabe

usage of rock shelters reveals elements of continuity. Hadzabe oral tradition suggests that rock shelter usage is a long established tradition (see Ndagala and Zengu 1989). In talking with Hadzabe about their ancestors, stories were often told about having lived in rock shelters. In addition, the Hadzabe feel a sense of pride about rock paintings. Thus, they are attached to past places found on their landscape.

Although no information concerning Hadzabe ritual and ceremonial activities (e.g., "epeme" dance) were collected during the research, it is possible that such activities are performed exclusively in certain portions of the landscape. Nevertheless, no evidence of ritual and ceremonial material culture were found in rock shelters occupied by the Hadzabe (c.f. Lim 1992).

Modeling Hadzabe Spatial Land-Use Patterns in the Eyasi Basin

As previously noted in this chapter, the dominant element that influences Hadzabe mobility is the availability of food resources. These in turn, vary in space and time (Table 5-1). As noted in Chapter 4, the Eyasi Basin experiences two major climatic seasons (wet and dry), each excellent in its provision of food, water, and shelter. These seasons also favor the Hadzabe's coexistence with their neighbors. Based on discussions with Hadzabe and their neighbors, and my personal experience of the Eyasi Basin, I

tentatively identify four Hadzabe land-use and resource utilization systems.

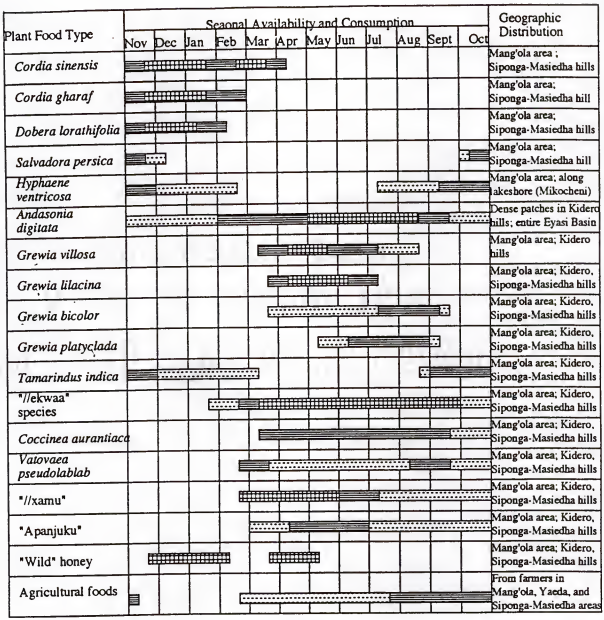
Inland land-use and resource utilization pattern in the hilly and rocky areas of Masiedha-Siponga. This inland area of the Eyasi Basin is used during the wet season, from late November through late May, when the number and quality of exploitable resources increase. Water, plant foods, and game animals are widely available and the Hadzabe move from the lakeshore areas to farther inland to use these resources. Berries *(Cordia gharaf, C. sinensis,* and *Salvadora persica)* ripen during late November and are intensively utilized by the Hadzabe. Hunting and scavenging of large game are intensified during this time because wild game is available. Edible tubers, roots, leaves, and shoots also become abundant during the rainy season. The "//ekwaa" species, "apanjuku", "matukwaiyaku", and "//xamu" tubers are especially important since they are ready for exploitation during and after the rainy season when all other plant foods (e.g., berries) may have been nearly exhausted. According to our Hadzabe informants, "//xamu" is the most desirable plant food. Honey, also, becomes available during this period. A large majority of these plant foods are found at the bottoms of hills and valley fringes.

During this season, the Hadzabe live in simply constructed shelters near Masiedha-Siponga hills and their rocky outcrops. In 1993 we found one abandoned base camp that had been occupied during the 1992 rainy season. This

abandoned base camp was composed of 10 simple huts. It was located near rock shelters of the hills in an area rich in wild plant foods, particularly "//xamu" and "//ekwaa" tubers. Also, baobab trees surrounded this abandoned base camp. The shelters consisted of poles supporting a roof made of grass with no walls. The sleeping areas of the huts were covered with soft grasses to provide comfort while sleeping. Generally the shelters are small, for up to no more than 3 persons per shelter, with a simple hearth. As they fall down, they are erased from the landscape. About 30 Hadzabe foragers occupied this camp in 1992 (Madulu Mahiya, personal communication).

In addition, the Hadzabe occupy rock shelters found in the nearby hills and rocky outcrops. Remains of Hadzabe material culture such as broken tobacco pipes, calabash fragments, food debris, fire sticks, hearths, meat-hanging pegs in rock crevices, beads, a hide ring, etc., were found at abandoned base camps and on rock shelter floors. Rock shelters with evidence of recent occupation by the Hadzabe were recorded at various locations within the study area. Since rock shelters are fixed in the landscape, their relative state of comfort is known in advance. Occupation of these shelters as described by Hadzabe informants is generally limited to times of heavy rains and occasionally as overnight camps during hunting and gathering missions.

Table 5-1: The Spatio-temporal Distribution of Plant Food in the Eyasi Basin.
(Adapted from MacDowell 1981).



The second land-use strategy is practiced during late May to late July. Hunting and scavenging activities of large game continue inland although at a lesser extent due to animal out migration. Tuber and root foods such as "//ekwaa", "shumuko", and "matukwaiyaku" are still available, although in smaller quantities. Utilization of tuber and root foods is minimized during this time because of low quality (bitterness and increases in fiber) and increasing difficulties in digging with digging sticks. Instead, the Hadzabe depend more on the baobab (*Andansonia digitata*) trees that dominate the Hadzabe landscape, with dense patches in the Kidero Horst and inland areas that fringe the Yaeda-Endanyawishi Graben. The fruits have a pleasant flavor and are rich in vitamin C. The white pith covering the seeds is extracted by the Hadzabe to form flour that is used to make a thick porridge. The seeds themselves are eaten as nuts and are rich in fat content.

The dry season is the harvesting time for the inland agriculturists and agro-pastorists. Some Hadzabe families or individuals provide casual labor to the agriculturists in return for food and other preferred commodities. They also scavenge for corn and other food remains in harvested farms. Some Hadzabe groups live in simple constructed shelters near corn farms and wet streams where water wells can be simply dug. Other Hadzabe live in temporary camps fringing the Yaeda-Endanyawishi Graben and in the Kidero Horst foraging for wild food resources. This suggests that forager

dependence on farmers in prehistoric times was untenable. Hadzabe groups, a family, or individuals are involved in this second type of land-use. The Yaeda-Endanyawishi Graben is frequently crossed by the Hadzabe during this time, but rarely exploited for food resources, and never occupied.

The third Hadzabe land-use pattern is that of early August to early November. This is a period of maximum dryness in the hilly and rocky areas of the inland region. Water and food resources become scarce. During this time, some Hadzabe groups move from the inland areas to residential base camps in the Mang'ola Graben. Others stay inland in large base camps southeast of the Masiedha-Siponga Hills along the southern bank of Udahya River. In 1993, large groups of semi-settled Hadzabe moved from Mungo-wa-Mono because of water and food shortages to the southeast of the Masiedha-Siponga Hills. These dry season base camps are located near stream drainages that supply water year round or water holes. As Bunn et al. (1988) note, these dry season water sources have possibly been used by generations of Hadzabe and provide a focal point for nocturnal hunting (Bunn et al. 1988). My observations show that during this time, hunting and carcass scavenging activities are primarily restricted to small and medium sized animals and birds. Hunting and scavenging big game are drastically reduced during the dry season.

Some Hadzabe groups live in base camps in Mang'ola, particularly in Mikocheni village exploiting sweet potatoes

that become available in large quantities during this time. I observed some Hadzabe utilizing the palm fruits (*Hyphaene*) that are available along the northern lakeshore from Gisimangedha to Mikocheni. Others live in the government settlements at Endamaghy village. Those groups that live at the government settlements depend much on food assistance from the government. In Mang'ola, gathering of berries is intensified during late October and early November, and the Hadzabe who live in the government settlements at Endamaghy and those who worked for agriculturists in return for sweet potatoes began to abandon these areas to go back to a foraging way of life.

Cordia gharaf, C. sinensis, and *Salvadora persica* ripen during this time in the Mang'ola area with dense patches in the Mbarai riverine system, especially at "Kambi ya Simba" or "Kambi ya Mkaa". For six to eight weeks, groups or families of Hadzabe move across the landscape in the Mang'ola area in search of ripening berries. Also tubers and root foods that fringe the Mbarai riverine system and those found on the bottoms of Lemagrut and Oldeani volcanic mountains are utilized by the Hadzabe forager during this time in Mang'ola. Isolated hunting activities directed at baboons (*Papio anubis*) occur in the *Acacia xanthophloea* woodland surrounding the natural springs (e.g., Gordfani). Baboon meat is highly valued by the Hadzabe foragers for its protein and medicinal uses. It is believed that baboon meat when eaten and the fat applied on the body, protects the Hadzabe from diseases and

evil spirits (Manjano Mahiya personal communication 1992). The occurrences of baboon bones in the "Nasera" Industry (MSA/LSA transition) levels at Mumba and Nasera rock shelters (Mehlman 1989), suggest possible great antiquity in the utilization of baboons by foragers in the Eyasi Basin.

The fourth Hadzabe land-use pattern encompasses the previous three land-use patterns. My observations show that the Hadzabe can traverse the landscape for ecological, cultural, or economic reasons or a combination thereof. Individual people or specialized groups (for example, hunters following up wounded game) are involved in such movements. The land-use markers resulting from such activities are overnight camps. Several recently abandoned overnight camps were observed across the Eyasi landscape. The Hadzabe material culture found at these overnight camps was scanty, primarily food debris, a fire place, fire sticks, and a simply constructed shelter.

Archaeological Implications

As noted previously, Hadzabe foragers interact with resources at different temporal and spatial scales. Based on the availability of exploitable plant resources, water, seasonal movement of game, and the resource utilization pattern of the Hadzabe, a seasonal land-use pattern is hypothesized for the MSA and LSA forager populations in the Eyasi Basin. Judging by Hadzabe modern land-use, I postulate that this pattern would have been partially dependent on

seasonality, food resources (including water) and their spatial distribution and abundance, and the migration pattern of game. Just as modern Hadzabe move seasonally across the landscape in pursuit of resources and shelters, it is possible that MSA and LSA foragers used their landscape in approximately similar ways. The plant foods, water, and game resources of the region fluctuated in availability as well as in yield and quality seasonally. During the wet seasons there were dense patches of tubers, roots, and abundant wild game and honey. During the early dry seasons there were plentiful baobab fruits and nuts. During the late dry seasons there were plentiful exploitable berries such as *Cordia gharaf, C. sinensis* and Salvadora *persica*. Such a pattern of resource availability, quality, and distribution must have permitted a flexible foraging economy and land-use strategies in which MSA and LSA foragers were able to utilize the regional landscape.

Similarly, the Hadzabe data shows that the above ecological and economic factors are in no way the only factors structuring Hadzabe land-use and resource utilization in the Eyasi Basin. Less tangible cultural variables play equally important roles in structuring Hadzabe resource utilization and land-use. While ecological and economic conditions always must be part of any processual explanation of how, when, and why members of a certain foraging society distribute themselves across the landscape, this study shows that ecological and economic factors are not the only ones

that need to be considered. Direct archaeological evidence for these cultural influences of mobility (e.g., mate search, conflict avoidance, etc.,) is meager, however. It is nonetheless hypothesized that MSA and LSA forager land-use in the Eyasi Basin was also linked to cultural factors like those of the extant Hadzabe foragers.

The overall Hadzabe organizations of land-use emphasize the continuous spatial use of the Eyasi Basin. Hadzabe rarely re-occupy abandoned base and temporary camps. Even though certain locations are particularly favored for habitation during a certain season, the Hadzabe usually choose a fresh nearby area when they return, unless the abandoned habitation is a rock shelter or has some other cultural attraction (also see Woodburn 1972). Therefore, the consequences of an ethnographic inference based on Hadzabe land-use behavior will be a continuous spatial record. We would then expect the archaeological implication of Hadzabe land-use behavior to be a continuous distribution of archaeological materials across the landscape, demonstrating the continuous spatial use of the Basin by prehistoric foragers. Since Hadzabe foragers traditionally do not re-occupy abandoned camps (except rock shelters), this behavior is reflected by few Hadzabe artifacts at abandoned open base camps as compared to those found in rock shelters that are usually re-occupied. Using the behavior of Hadzabe foragers, I hypothesize that, MSA and LSA foragers very seldom re-occupied their open habitation base camps. In the

archaeological record of the Eyasi Basin, I expect to find such behavior reflected by thinly distributed archaeological materials at open settlements as opposed to stratified archaeological deposits in rock shelters that I presume were regularly re-occupied.

Traditionally, the Hadzabe do not move outside the Eyasi Basin. This is because all the resources necessary for their survival are readily available. As a result, Hadzabe land-use and resource utilization patterns have been stable through time and space. Ultimately, this has allowed the development of a regionally patterned land-use and resource utilization (planning and foresight) behavior.

Judging by the modern movement of Hadzabe foragers, the economic lifetime space of MSA and LSA foragers could also have been primarily confined to the Eyasi Basin. I envisage that MSA and LSA foragers in the Eyasi Basin also had stable and continuous regionally patterned land-use and resource utilization behaviors like the extant foragers. In the archaeological record, this behavior will be reflected by an emphasis on regionally and locally available raw materials for making lithic artifacts by both MSA and LSA foragers, despite possible knowledge of non-local materials such as good quality chert from Olduvai Gorge and the Lake Natron Basin, and obsidian from the Kenya highlands (see Chapter 9).

This hypothesis has major implications for identifying the threshold or (more likely) thresholds that separate pre-"modern" from "modern" human behavior at the MSA/LSA

transition in the Eyasi Basin. Different or similar land-use and resource utilization patterns between MSA and LSA in the Basin will be considered as expressions of fundamentally different or similar conceptual frameworks of the Eyasi landscape. In my opinion, the different or similar land-use and resource utilization patterns by MSA and LSA foragers in the Eyasi Basin may be the most significant and critical contrasts in differentiating MSA from LSA forager behaviors. Both MSA and LSA forager materials have been found in the Basin (Mehlman 1989; Chapters 7 and 8).

The occurrences of Hadzabe and prehistoric forager artifacts in rock shelters clearly illustrate the importance of rock shelters to modern and prehistoric foragers in the Eyasi Basin. These rock shelters were undoubtedly important during prehistoric times as they offered shelter from rain, sun, wind, and predators, and provided needed warmth. The continuous use of these shelters suggests: 1) the desirable physical attributes for all occupied shelters have remained stable through time; 2) the cultural preferences of rock shelter inhabitants have remained stable; 3) or both. Ultimately, this suggests that forager perception or cognition of the Eyasi landscape has been relatively stable, so that one finds contemporary forager usage of shelters with prehistoric paintings and artifacts. Does this suggest, perhaps, also continuity in forager demography, land-use and resource utilization systems, and social organization through time from MSA to present? For example, if a rock shelter

with a floor of 47.4 m^2 is occupied by a Hadzabe family of six individuals, is it also possible that families of approximately six individuals occupied similar rock shelters in prehistoric times? These possibilities have important implications for understanding not only the anthropogenic behaviors of prehistoric foragers in the Eyasi Basin, but also their population density. Prehistoric population estimates provide the necessary data needed to formulate and test hypotheses about the relationships between demography and past socio-economic conditions, land-use patterns, burial patterns, and other aspects of past cultural systems (Hassan 1987; Jochim 1976; Wobst 1975). Unfortunately, many of the attempts to consider group size according to camp space are based on open occupation spaces (Hassan 1981; Yellen 1977; Weissner 1974). The results of such studies cannot be directly applied to shelters, because space is unrestricted on open sites, whereas rock shelters impose constraints on group size and access (Walker 1995). Evidently, this preliminary study of rock shelter utilization by the Hadzabe foragers points to interesting avenues of research on the relationships between demography and past forager systems.

A recent demographic study of the Hadzabe shows that the regional density for the full time foragers is about 0.24 per square kilometer (Blurton Jones et al. 1992). On the basis of demographic census data recorded in 1966 and 1985, Blurton Jones et al. note a Hadzabe population growth rate of 1.3-1.4% per annum, culminating in 750 Hadzabe individuals during

the 1985 census. As previously noted in this chapter, Hadzabe population at present, is estimated to be between 600 and 800 individuals. This suggests that there has been no major change in Hadzabe demography for the past three decades (also see Blurton Jones et al. 1992). In spite of the historical context of Hadzabe demography since the turn of the last century (e.g., raids by Maasai, Isanzu, and Sukuma; epidemics, and other hazards [Blurton Jones et al. 1992 and references therein]), on a diachronic scale the Hadzabe population seems to be stable and below the carrying capacity of the Eyasi landscape. Persistence through time of regionally patterned Hadzabe demography bears witness to underlying elements of stability and continuity--apprehended here on a diachronic scale. On this basis, I envisage a low population density of MSA and LSA foragers who also lived below the carrying capacity of the Eyasi landscape.

My observations of Hadzabe discard patterns in rock shelters show that the geomorphological character of the shelters limits the amount of flat ground beyond the dripline. Consequently, the exterior talus slopes are frequently scattered with discarded food debris and other material culture. This finding clearly shows that archaeological excavations located primarily in the center of shelter floors are likely to uncover materials that are un-representative of the activities that took place (assuming Schiffer's [1995] n- and c- transforms are constant). This has major archaeological implications because cave and rock

shelter deposits often are assumed by archaeologists to be sealed deposits representing most, if not all, the prehistoric activities that took place. Hadzabe discard patterns in rock shelters show that such assumptions may be very wrong. This study shows that discard patterns and spatial usage of rock shelters can be influenced by: 1) behaviors of the occupants; 2) amount of space available; 3) amount of discard material; 4) anticipated time of occupation; or 5) a combination of these factors. In turn, these factors can also limit the number of rock shelter occupants as well as the amount of discarded materials on the shelter's floor. In the future, I will explore further the influences of these five aspects and I will look at the interrelations between them in both prehistoric and modern foragers of the Eyasi Basin.

Although the Hadzabe do not paint on rock faces, they claim authorship of the prehistoric art in the Eyasi Basin (Hadzabe foragers personal communication 1992, 1993). This claim has significant archaeological implications as the Hadzabe seem to be untapped sources of possible historical connections to rock art production and other archaeological phenomena in the Eyasi Basin. One obvious problem that faces rock art archaeology is the interpretation of the meaning of the images and an understanding of the people who produced them. Few archaeologists have asked questions regarding the contexts of rock art production, that is, the economic, political, symbolic, social, religious, territorial, or

ecological contexts (also see Lim 1992). To search for answers to the question of contexts, archaeologists need to learn and understand the structures of the systems of human organizations that were associated with the prehistoric images. An understanding of the relationship between rock paintings and other aspects of rock shelter usage in the modern context will facilitate an understanding of prehistoric rock shelter usage and the contexts that conditioned the production of rock art by prehistoric foragers (also see Lim 1992). This makes it necessary, I believe, to collect other kinds of data such as information on the palaeoecology and archaeology of the time when rock art was made, as well as present ethnographic data. Ethnographic rock art data and the usage of rock shelters by contemporary Hadzabe foragers can provide sources for hypothesis generation and testing concerning the meaning of prehistoric rock art and the motives behind its production. A systematic study of why, when, and how the Hadzabe use the rock shelters and specific paintings will therefore help in interpreting meaning and understanding of the contexts of prehistoric rock art production in the Eyasi Basin.

Moreover, since Hadzabe occupation in rock shelters is limited to periods of wet seasons and as overnight camps, the Hadzabe materials recorded in these shelters thus represent short-term occupational events. This has major implications for understanding prehistoric rock shelter paintings and usage in the Basin. Eyasi Basin rock shelters have yielded

diverse archaeological materials including MSA, LSA, and Pastoral Neolithic stone artifacts, human skeletal remains, rock art, animal bone remains, pottery, ostrich eggshell beads, and Iron Age materials (Mehlman 1989; Chapters 7 and 8). If we are to understand the occupational histories and activities that produced the prehistoric cultural materials in these rock shelters, and the meaning behind the paintings we must examine the relationship between the rock shelters and landscape and the relationship between landscape and prehistoric forager land-use and resource utilization patterns through ecological, cultural, and economic contexts.

Based on Hadzabe data on rock shelter usage, I hypothesize that MSA and LSA foragers in the Eyasi Basin also occupied the rock shelters and painted them during the wet seasons and occasionally during hunting and gathering missions when they were used as overnight camps. I also argue that the habitation use of rock shelters was the primary reason that attracted prehistoric foragers to them in the first place and that painting was secondary (cf. Lim 1993).

Hadzabe Foragers Today: An Endangered Cultural Species?

Were I to comment in brief about Hadzabe forager existence in the twenty-first century, I would say that 1) their present is transitional; 2) as for their future, they have no future at all, if present conditions continue; and 3) the solution(s) to their survival as a cultural group is

nowhere in sight. This view is also shared by many, if not by all Hadzabe foragers. In this case, the question then is, how can land-use and resource utilization behavior generated from a Hadzabe foraging system be applied to the archaeological record of MSA and LSA? Unfortunately, many researchers do not address this crucial issue (e.g., Bunn et al. 1988; O'Connell et al. 1988). Before I deal with this issue, let me summarize the events that have contributed to the Hadzabe's present condition.

In talking with Hadzabe about their survival as a cultural group, comments were frequently made on two major issues: 1) encroachment of their land by non-forager groups; and 2) government interventions into their foraging system.

Encroachment by non-forager groups. The Hadzabe of today, faced with major encroachment by non-forager groups upon their foraging land, are finding they can no longer exist using the traditional foraging system if this infringement is not stopped. Ethnographic information shows that at the time of European contact, around the beginning of the last century, the Eyasi Basin was occupied exclusively by Hadzabe foragers (Woodburn 1964). This assertion is also supported by Hadzabe oral traditions, as the Hadzabe of today claim that their ancestors were the autochthonous of the Eyasi Basin (Ndagala and Zengu 1988). In fact, local incursions by Mang'ati pastoralists, Iraqwi agropastoralists, and other agriculturist groups have been recorded in historic times as early as the beginning of the last century (McDowell

1981; Obst 1912; Woodburn 1964, 1988). Today, the Eyasi Basin is largely populated by non-forager groups of different ethnic origin including Europeans. As noted in Chapter 4, some of these non-forager groups practice commercial farming along the lower Mbarai River in Mang'ola. Others are pastoralists, agropastoralists, peasants, miners, fuel energy collectors (charcoal and firewood), missionaries, teachers, health service personnel, and traders. As the density of non-forager groups and their needs have increased, there has been a marked diminution of food resources for the foragers. Large tracts of land have been cleared, either for farming or as a result of tree cutting for building and fuel energy. The increasing herds are degrading the environment and the water sources. Legal and illegal hunting have significantly reduced the number of game in the area. In short, the increasing number of non-forager groups in the Eyasi Basin destroys the "food habitats" and reduces and continues to diminish the variety of flora and fauna utilized by the Hadzabe. Accordingly, it reduces the ability of Hadzabe foragers to support themselves on naturally produced resources.

The solution(s) to the encroachment problem is complex. It will be a political issue since it involves rights, property-productive resource (land), and ideology. Perhaps the most problematic issue is land ownership. As perfectly described by Woodburn (1980), the Hadzabe are mobile, egalitarian, immediate-return foragers. As such, the land

for foraging is used and owned communally. Ownership of the foraging land in the Hadzabe view is based on their being indigenous to the Eyasi Basin. In contrast, non-forager groups in the Eyasi Basin, and the Tanzanian Government in general, view land as a multiple-use resource, of significance to the entire nation. Plantations, game parks, farming, mining, tourism, commercial hunting, etc., are all potential uses for any land in the nation. Accordingly, the land can be used and owned either privately or communally. This is one major institutional difference between Hadzabe forager and non-forager groups in the Eyasi Basin. Through the government land tenure system and non-forager customs concerning land ownership and inheritance, the Eyasi Basin is increasingly being fragmented and turned into free hold private ownership. Since the Eyasi Basin has passed and continues to pass into new uses (i.e., unrelated to foraging), the Hadzabe foragers are experiencing increasing pressures and difficulties in continuing their traditional life style.

Government interventions. Attempts to induce the Hadzabe to relinquish their mobile way of life and shift their foraging subsistence pattern to food production and sedentary life have been made repeatedly since the turn of the last century. After Tanganyika (now Tanzania) achieved her independence from colonial domination, the government required citizens to live in one place, receive social services, and intensively utilize the natural resources to

produce and contribute to the national economy (Nyerere 1971). Thus, the fate of the Hadzabe foragers became tied to the emerging national political, social, and cultural system (see also Kaare 1993). Throughout the years following independence to the present, Tanzania and multinational organizations (e.g., World Bank) have endeavored to convert Hadzabe foragers to sedentary peasants (PMMO 1990, 1992) in an effort to prevent their eventual demise. In essence, this view is based on a flawed 19th century theory of social evolution (the "noble savage") wherein by sedentarizing the foragers, the state integrates them into the nation's socio-economic and political systems while also insuring their survival as a people.

Such recent efforts are essentially the continuation of colonial experiments. To ensure the future survival of the Hadzabe, the Tanzania government has in recent years established a comprehensive development program that includes free education and health services, free bee keeping, animal husbandry, and agricultural inputs (PMFPO 1990, 1992). The major goals have been to alleviate poverty and guarantee "basic human needs" among the Hadzabe. To realize these goals, the government has required the Hadzabe to become sedentary. Unlike previous development programs, the recent ones claim to have involved the beneficiaries (*i.e.*, the Hadzabe) in the identification, planning, and implementation of the programs (PMFPO 1992). This claim is supported by several workshops and lists of names of Hadzabe forager

participants provided in the 1990 and 1992 reports to the Prime Minister and First President's Office. Coincidentally, seven of the Hadzabe participants in the 1990 and 1992 Government workshops were also my field crew members and consultants.

Because my major interests were in archaeology, I was unaware of the recent Government anthropogenic programs on the Hadzabe. Initially, my Hadzabe field crew and consultants were skeptical as they thought my research was a pretext, camouflaging with a goal of spying on them for the Government. After several weeks of assurances that I wasn't working for the government, they began to talk about the government settling programs. The same people who participated in the Government workshops did not approve of the Government programs two years later. I suspect this was because the basic questions concerning the relationship between the aspirations of Hadzabe themselves and what is expected of and for them by Government and development planners were not fully explored. Individual Hadzabe cannot transform the aspirations of the egalitarian community nor can individual Hadzabe involvement in mainstream decision-making processes lead them to either rely upon or accept the opinions of the generally. Unfortunately, such opinions frequently are colored by values, prejudices, and rationalization of the dominating culture.

As the foregoing discussion indicates, the Hadzabe foragers have experienced and continue to experience

pressures to relinquish their traditional life style. Since they lack a political platform in their society and in the nation's political system (Woodburn 1979), they have resisted and continue to resist the pressures by withdrawing their children from free schools, abandoning the established farming villages and returning to the bush, boycotting Government health services, and rejecting Government employment in the towns. Even educated Hadzabe may return back to the bush. As Kaare (1989, 1993) notes, the Hadzabe have neither adopted sedentary life nor has formal education helped to "modernize" them as anticipated by the State.

The Hadzabe frequent abandonment of government settlement schemes and their movement back to the bush reflects a strong desire to maintain links with the landscape that allows them to live lives that are consistent with their desires and aspirations. For the Hadzabe, hunting and gathering activities still have important social, cultural, and economic benefits. Hadzabe traditional foods remain highly valued, both culturally and socially, and mobility remains an important variable in their biocultural adaptations to the Basin.

By understanding the Hadzabe foraging system and their mobile life style, we can begin to see a defined and organized system based upon the belief that the landscape provides their basic needs, and their way of life is meaningful. Clearly, ecological, economic, and cultural factors dictate and govern Hadzabe movements and resource

utilizations, but a closer look helps us realize that the Hadzabe are implementing bonafide organized cultural land management programs.

To cope with the ecological and social pressures, significant strategies used by the Hadzabe include: 1) a social system, involving exchange relationships within and outside the forager group; 2) a technological system, involving simple technology; 3) an economic system, involving barter trade, monetary trade, and working for non-forager groups; and 4) a land-use system, involving spatial mobility. These social, economic, ecological, and technological strategies have evolved through time in an effort to co-exist with the Eyasi Basin marginal landscape, encroachment by non-foragers, and Government interventions. Any attempt to make the Hadzabe relocate to permanent settlements would violate their world view about good health, lifeways, food abundance, etc. Clearly it would destroy a foraging system intertwined with the ecological, cultural, and economic constructions of their lifeways, the landscape, and its resources. Overwhelmingly, these are the pressing concerns of Hadzabe daily life. Perhaps, it is time to take Hadzabe insights, knowledge, and world view seriously, since Government plans that do not coincide with their desires and aspirations are bound to fail. An important first step is to acknowledge the value of the forager common land tenure system as a legitimate means of livelihood for the Hadzabe.

As a counter to the old orthodoxy and as a means of averting what is happening to the Hadzabe, I suggest that the aspirations and desires of Hadzabe themselves should be our starting point and scientific, economic, medical, social, and other advice should be used to support these, rather than to discourage. The foraging system of the Hadzabe still supports a coherent traditional and sustainable foraging culture and population. I believe that we can ensure Hadzabe existence and integrity without significantly changing their way of life. I am not inspired by a sentimental preoccupation with the preservation of a supposedly "pristine" society but rather to suggest a way in which the Hadzabe can maintain their own history and survival.

My major task now is to answer the question posed at the beginning of this section. How can foraging behavioral models and hypotheses generated from Hadzabe foragers be applied to the archaeological record of MSA and LSA? The extent to which one may extrapolate from extant foragers to prehistoric ones remains an open question (Lee 1992; Lee and Guenther 1991; Wilmsen 1989; Wilmsen and Denbow 1990; Woodburn 1980). It is clear in this chapter that the social, political, and economic relationships with non-forager groups and government interventions have contributed to the present situation of the Hadzabe foragers (see also Woodburn 1980). Today, approximately one-fourth of the total population continues to practice a full time traditional foraging lifestyle (Bunn et al. 1988; O'Connell et al. 1988). The

rest practice a combination of part-time traditional foraging and other production activities. Whether the latter economic system is a product of recent developments, is not clear. Nonetheless, the archaeological record suggests that prehistoric foragers and farmers co-existed in the Eyasi Basin from about 3,000 BP (Mehlman 1989).

As noted earlier in this chapter and Chapter 6, the data used to generate the testable hypotheses about MSA and LSA land-use were collected from the eastern Hadzabe who continue to practice a full time traditional foraging lifestyle. As concisely described by Woodburn (1979, 1980), these Hadzabe continue to be mobile foragers and positively value movements; do not accumulate property; have simple technology; use portable, utilitarian, easily acquired and replaceable artifacts; and lack a political platform. Other scholars have shown that some of the characteristics of systems behavior of contemporary foragers are low rates of discard of items of material culture even at habitation bases, continuous discard of items throughout a foraging range, and relocation of habitation bases near but not directly on top of previously occupied base camps (Yellen 1977). These are the essential features of a Hadzabe foraging system as also described in this chapter. Whether the Hadzabe foraging system is representative of true MSA and LSA foraging systems is not the issue here. As Burch argues:

> the critical issue is not the basis on which a model is developed, but the extent to which it increases our understanding of the relevant phenomena in an empirically supportable way... if a measurably distinct

> class of societies (e.g., foraging societies) can be delineated, and if an empirically testable model of that class can be developed, then the model should apply to all members of that class, regardless of when they existed in time. (1994, p. 446)

Likewise, Bettinger, notes that:

> it is the processes and principles that govern dynamic systems, both past and present, that are important. First-hand observation of contemporary systems may help us to think about principles and processes, but the principles and processes necessarily transcend individual cases, however instructive these cases might be. (1991, p. 79)

One must accept that empirical generalizations about the archaeological record of foragers are difficult to come by and that meaningful generalizations about the record must be informed by behavior of foragers in real-life. It would be a mistake to write off our best data about foragers in real-life just because of contact with neighbor societies and government interventions and projections (see Solway and Lee 1990; Woodburn 1988). Knauft notes that, "if anything, the historical changes that have impacted foragers in this century have served to reduce rather than artificially increase the distinctiveness of these societies" (1991, p. 392). In terms of behavioral evolutionary ecology, the distinctive features of extant egalitarian foragers are unlikely to have been a function of modern developments (Woodburn 1988). Therefore, ethnographic observations and reasoning can help us imagine what such an archaeological record of foragers might look like, given some understanding of their dynamic systems (Ebert 1992; Woodburn 1980, 1988). Indeed, careful articulation of ethnographic with

archaeological research is indispensable to the development of penetrating views of human sociocultural developments (Bunn et al. 1988; Foley and Lee 1989; O'Connell et al. 1988).

Summary

As noted earlier, how the Hadzabe use their landscape has not received sufficient attention, although it can provide important insights into an understanding of the use of the landscape in the Eyasi Basin by prehistoric foragers. Three of the four Hadzabe land-use and resource utilization patterns described in this chapter are seasonal in character and largely structured by resource availability, quality, and predictability. This study, however, shows that other factors also structure Hadzabe mobility patterns. While ecological and economic conditions always must be part of any processual explanation of how, when, and why members of a certain foraging society distribute themselves across the landscape, this study shows that ecological and economic factors are not the only ones that need to be considered. What is more important, this study investigated the motivations that influence Hadzabe forager movements either at the "group" or "individual" level. Clearly, this approach departs from conventional forager ethnographic research that largely focuses on the "group" level. From figure 5-1, we see that "individual" Hadzabe foragers move across the landscape to fulfill a variety of needs, objectives, and

strategies. These factors are personal and based on individual decision-making and judgments. At the group level, any Hadzabe movement involves a collective decision, or at least a degree of discussion. That is, Hadzabe group movements are dependent on social and economic actions, interactions, and the dynamics of social organization. Thus, while for scientific purposes it is possible to study MSA and LSA land-use and resource utilization systems objectively by using "group" level generalizations without reference to "individual" level, it is necessary to see them as the products of both "individual" and "group" adaptive behaviors.

Furthermore, the study shows that Hadzabe land-use patterns are repeated at different times, durations, and places as selective forces in the regional ecology, human economy, and culture recur. The overall Hadzabe use of the landscape is continuous and the resulting land-use system seems to be stable through time. An archaeological interpretive framework must recognize, therefore, the importance of ecological, economic, and cultural constraints on pattern building in the archaeological record. On the basis of Hadzabe inferences drawn from interactions with the Eyasi landscape, this chapter has provided much of the ecological, economic, and cultural contexts for prehistoric forager spatial land-use and resource utilization in the Eyasi Basin, data that are not obvious from the archaeological record alone. These data and ideas are formulated as testable hypotheses in the next chapter.

CHAPTER 6
HYPOTHESES FORMULATION AND RESEARCH METHODS

Introduction

In the preceding chapters, in particular Chapter 3 on previous archaeological investigations, I have highlighted the necessity of research programs that consider the spatial behavior of MSA and LSA foragers in East Africa. In this chapter, I draw upon data on MSA and LSA of East Africa (Chapters 2, 3, and 4) and the Hadzabe forager data on land-use and resource utilization (Chapter 5) to generate testable hypotheses about MSA and LSA spatial behaviors in the Eyasi Basin. In addition, I describe how such an archaeological approach was implemented in the Eyasi Basin.

Hypotheses Formulation

Although the MSA and LSA are intriguing periods in human history, the lack of anatomical and behavioral data on the MSA of East Africa remains a chronic problem. This has resulted in a rather muddled image of our own distant past. In particular, the interpretations of hominid behavior at the MSA/LSA transition as summarized earlier in Chapter 2 remain largely controversial. In this study, I view behavior as a set of "adaptive strategies" that evolve as humans deal with

the question of survival and want. As a set of "adaptive strategies", behavior requires various degrees of anticipation, desire, foresight, and planning (Bennet 1993). From this perspective, it follows that behavior is responsible for the degree of socio-cultural interactions between individuals and groups and the landscapes in which they live or have lived. Thus behavior is of vital importance for understanding hominid biocultural evolution and subsequent adaptations to the landscapes.

With this in mind, I propose that one way to differentiate MSA from LSA forager behavioral patterns is to examine how MSA and LSA foragers organized and used the landscape. The hypotheses to be tested are offered here as possible explanations of MSA and LSA adaptation as reflected by the distribution of archaeological material across the landscape and the organization of lithic technology. Alternate hypotheses are considered in order to evaluate the degree to which different or similar MSA and LSA land-use patterns of the Eyasi Basin could lead to similar or different artifact distributional patterns and lithic technological organization.

It could be suggested that hominid utilization of the Eyasi Basin was independent of the environmental conditions that existed during MSA and LSA times. If this was the case, then, the land-use patterns of MSA (without "modern" behavior) and LSA (with "modern" behavior) foragers should,

in principle, be different. This leads to my null hypothesis:

H0: Hominid utilization of the Eyasi Basin did not change in extent and structure during the MSA and LSA.

Archaeological implications. If this was the case, then the patterning of MSA and LSA artifacts in different portions of the landscape will be similar. MSA and LSA artifacts would be found in association within the same sections of the landscape. At multi-component habitations, MSA materials should be found stratified below LSA materials. This association of the activity remains of MSA and LSA foragers would suggest that whatever factors that influenced MSA foragers to use certain areas of the landscape, they also influenced LSA foragers.

In terms of the organization of lithic technology, I anticipate that the LSA record would be characterized by some elements of MSA technology, toolkits, and continuation in the utilization of raw material types. Both MSA and LSA assemblages would show either a high or low proportion of exotic raw materials. All this will suggest that the land-use patterns of MSA and LSA foragers in the Eyasi Basin were not remarkably different, suggesting perhaps greater "continuity" or "gradual" changes in the foraging system (e.g., population, resource utilization, organization of technology, social organization, etc.,).

The alternative to the previous hypothesis is:

H1: Hominid utilization of the Eyasi Basin did change markedly in extent and structure between the MSA and LSA.

Archaeological implications. I assume that land-use of a specific period will tend to occur and recur in specific types of locations in the landscape. Land-use was not a random process but was directed by specific reasons and decisions. These reasons and decisions can be either behavioral or cultural, economic, ecological, geological, or various combinations of the above factors.

Assuming that LSA foragers were behaviorally different than MSA foragers, their perceptions and cognition of the Eyasi Basin would have been different from that of MSA foragers. In principle, LSA forager utilization of the Eyasi Basin would also have been different from that of earlier foragers with a MSA culture. From this perspective, the spatial patterning of MSA and LSA artifacts in different sections of the landscape would be significantly different. If this is true, then, MSA material will not be found in association with LSA material in the same sections of the surveyed areas of the landscape.

In terms of the organization of lithic technology, I would expect to observe "dramatic" shifts in the techno-typology and the procurement and use of lithic raw materials between the two cultural stages. Assuming that LSA foragers were more mobile or traded more than MSA foragers, then the proportions of high quality non-local lithic material should

be high during the LSA and low during the MSA. Accordingly, desirable exotic raw material may be found as less reduced forms in the LSA if it was procured more predictably and would be associated with more flaking debris. On the contrary, MSA assemblages would have contained small amounts of non-local raw materials which will be found primarily as discarded, heavily reduced pieces, with few cores and debitage. This would suggest an opportunistic procurement strategy of exotic raw materials by MSA foragers. Analysis of raw material and transport behavior of artifacts will allow an assessment of the organization of technology, which may be related to long-term occupation of an area and the degree of forager mobility.

Also, it could be suggested that hominid utilization of the Eyasi Basin was dependent upon the environmental conditions that existed during MSA and LSA times. In East Africa, palaeoenvironmental data suggest wet and humid conditions throughout the MSA and dry and cold conditions during pre-Holocene LSA (Chapter 4). Undoubtedly, these environmental changes adversely affected the vegetation cover and the spatio-temporal distribution of food resources and water. In particular, in the Eyasi Basin, the spatio-temporal distribution of food and water is critical for modern forager survival during dry conditions. Given these considerations then, MSA and LSA forager utilization of the Eyasi Basin was restricted in space and time. This assumption leads to the following null hypothesis:

H3: MSA and LSA foragers exclusively utilized the northern section of the Eyasi Basin where food and water from natural springs was easily accessible during the dry conditions.

Archaeological implications. On the basis of the available data (Chapter 4), I assume that there was abundant food and water resources along the northern section of the Eyasi Basin during pre-mid-Holocene dry conditions. The inland area, however, was dry and unfavorable for foragers and animal survival. This resource structure evidently reduced forager's mobility, resulting in intensive utilization of the northern section of the Eyasi Basin. I expect, therefore, to locate most if not all of the pre-ceramic LSA materials in the northern portion of the Eyasi Basin, along the lakeshore.

The alternative hypothesis is:

H1. MSA and LSA foragers utilized more than the northern section of the Eyasi Basin.

Test implications. Because of the wet conditions during the MSA and ceramic LSA times, food and water resources were widely distributed. This would have permitted foragers to increase their mobility in the Eyasi Basin. I expect, therefore, to locate MSA and Holocene LSA materials widely distributed across the Eyasi Basin.

In Chapter 5, I have shown that the foraging system of Hadzabe foragers operates in three domains: ecological, cultural, and economic. The first refers to the maintenance

of a foraging society in relation to the utilized resources of the ecology and landscape. The second derives its existence from how foragers perceive the ecology and landscape and how they relate to each other and position themselves in the landscape in efforts to meet the basic needs for their existence. The later include those forms of culture (e.g., social organization, subsistence and mobility patterns, and technology) that meet the needs for growth, reproduction, and maintenance of the society. The third refer to the economic factors not related to subsistence and the cultural contacts and relationships with non-forager groups. In historic times, this element is also important for the survival of many forager societies. In prehistoric times, perhaps it was important after the introduction of food production and pastoralism (Pastoral Neolithic).

In this section I use the Hadzabe land-use and behavioral patterns of resource utilization to formulate testable hypotheses about MSA and LSA forager land-use and resource exploitation behavioral patterns in the Eyasi Basin. The formulated hypotheses can be summarized as follows:

H1: A seasonal land-use pattern and resource utilization is hypothesized for the MSA and LSA forager populations in the Eyasi Basin.

Ethnographic assumption. Just as modern Hadzabe move seasonally across the landscape in pursuit of resources and shelters, it is possible that MSA and LSA foragers used their landscape in approximately similar ways.

Archaeological implications/tests: Direct evidence for seasonality is not readily available in the archaeological record. However, in the future I will study the seasonal cementum increments in mammalian teeth. This approach has been demonstrated by Lieberman and Shea (1994) and provides strong evidence for seasonal mobility among "archaic" and modern human populations in the Levant.

H2: MSA and LSA forager land-use in the Eyasi Basin, was also linked to cultural variables, but not necessarily those of the extant Hadzabe foragers (see Figure 5-1).

Ethnographic assumption. Less intangible cultural features play equally important roles in structuring Hadzabe resource utilization and land-use.

Archaeological implications/tests. This hypothesis is difficult to test archaeologically.

H3: MSA and LSA foragers very seldom re-occupied their open habitation base camps but regularly re-occupied shelter settlements.

Ethnographic Assumption. Hadzabe rarely re-occupy open base and temporary camps. Even though certain locations of the landscape are particularly favored for habitation during certain seasons, usually the Hadzabe choose a fresh nearby area when they return, unless the abandoned habitation is a rock shelter or has other cultural attractions.

Archaeological implications/tests. This behavior will be reflected by thinly distributed archaeological materials

at open settlements as opposed to stratified archaeological deposits in rock shelters that were apparently re-occupied. Accordingly, artifact diversity should be high and correlate with assemblage sizes at rock shelter settlements. Moreover, rock shelter assemblages will show a high diversity in edge angles of retouched tools. On the contrary, artifact and edge angle diversities should be low at open air settlements.

H4: MSA and LSA foragers used the entire landscape of the Eyasi Basin in their seasonal movements.

Ethnographic assumption. The overall Hadzabe organizations of land-use and resource utilization emphasize the use of the entire landscape of the Eyasi Basin. Therefore, the ethnographic consequence of Hadzabe land-use and resource utilization behaviors is a continuous spatial record.

Archaeological implications/tests. Continuous distribution of archaeological materials across the entire landscape, demonstrating the continuous spatial use of the entire Basin by MSA and LSA foragers.

H5: MSA and LSA foragers in the Eyasi Basin had localized patterns of land-use and resource utilization behaviors. The lifetime space of MSA and LSA foragers was primarily confined to the Eyasi Basin.

Ethnographic assumption. Traditionally, the Hadzabe do not move outside the Eyasi Basin. Ultimately, this has

allowed the development of a regionally patterned land-use and resource utilization (planning and foresight) behavior.

Archaeological implications/tests. In the archaeological record, this behavior will be reflected by an emphasis on poor quality, locally available lithic raw materials for making artifacts by both MSA and LSA foragers, despite possible knowledge of "exotic" lithic materials such as good quality chert from Olduvai Gorge and Lake Natron Basin, and obsidian from Kenya Highlands.

H6: I envisage a low population density of MSA and LSA foragers who lived below the carrying capacity of the Eyasi Basin.

Ethnographic assumption. A recent demographic study by Blurton Jones et al. (1992) shows that the overall population density of the Hadzabe for the past three decades has been relatively stable and below the carrying capacity of the Eyasi Basin. This regionally patterned Hadzabe demography bears witness to underlying elements of stability and continuity.

Archaeological implications/tests. Archaeologically, this will be reflected by an overall low density of artifact scatters in the surveyed areas except at multiple occupation locations such as rock shelters. It is important to note that this hypothesis is difficult to test archaeologically with the available data. However, in the future, I will conduct a systematic study of Hadzabe use of shelter's spaces; e.g., number of individuals per size of a shelter

floor, discard patterns and rates of discard of items of material culture, amount of items of material culture per occupation, deposition processes, and amount of Hadzabe items of material culture recovered from excavation. Undoubtedly, this type of research will provide pertinent data that can be used to infer prehistoric population density in the Eyasi Basin, if not in East Africa.

Field Research: Methodological Approaches

From the beginning, it was very much the intention of this study to employ an approach whereby the research program is one of landscape archaeology that combines ecological, geomorphic and archaeological field surface surveys, limited subsurface test excavations, and ethnographic study of modern Hadzabe forager mobility patterns.

Bower (1986) has argued for the need to produce coherent assessments of the aims, logistics, and methods of surface investigations. Only in these ways can readers make evaluations of the validity of the work undertaken. More importantly, however, this assessments specify: 1) the observations we consider relevant to solve a problem, and 2) the ways we organize our observations and analyze a particular body of data. Accordingly, in the following sections I outline the criteria for selecting the Eyasi Basin for survey, and I describe what was proposed to be done in the field and what was actually done. Also, I consider the

field logistics that made different our methodology of landscape archaeology in the Eyasi Basin.

Logistical Considerations

The research reported in this dissertation study was conducted over a period of eight months of field work. This was divided into two phases: from September 1992 to January 1993, and from August 1993 to November 1993. As noted in Chapter 2, survey needed to be carefully conducted to reveal by select sampling the general nature of the distribution of artifacts throughout the Eyasi Basin. Obviously such a survey also would be regulated by the physical and cultural bounds of the area itself.

To facilitate our work in the Eyasi Basin it was necessary to establish a base. The shortage of food supplies in the area and the need to acquire water made the Gordfani village in Mang'ola area an obvious place to establish this base. When we started working in the inland area, it became necessary, however, to move our base inland. Clean and safe water was unavailable inland and we had to drive to Gordfani, a distance of about 70 km each week to fetch water.

Field Methods

I proposed to conduct a systematic surface survey to investigate the spatial distribution and characteristics of Late Quaternary (MSA and LSA) forager activities across the Eyasi landscape. To accomplish this goal, I planned to grid

each eco- and geo-zone into 0.25 km^2 sampling units and to select 1% survey units from each eco- and geo-zone. Artifacts, ecofacts, or features were to be counted and flagged in the field as they were found rather than being collected immediately. After a given sampling unit was surveyed, the locations of artifacts were to be recorded and accurately mapped before collection. Dense artifact scatters were to be collected by aggregate provenience units (e.g., 1 meter grid square). A SONY PYXIS Global Positioning System (GPS) device was to be used in describing and locating landmarks and survey units in the field, as well as mapping the distribution of artifacts in a surveyed area. Likewise, a video camera was to be used to photograph each surveyed unit and the visual images were to be transferred later to a Macintosh database program for computer encoding of map data.

Once in the field, however, it became apparent that the original survey methods would have to be modified due to logistical considerations. The, rocky and tectonic landforms, thick vegetation cover in some areas, equipment problems, time constraints, and lack of specialized personnel biased our survey coverage, data recovery, and recording.

Although I had to change our field methods due to the previously noted logistics, our surface survey of the Eyasi Basin was still aimed at maximizing recovery of archaeological, ecological, geomorphic and ethnographic information, and to collect a representative sample of palaeoanthropological remains. Given the hypothesis that MSA

and LSA foragers were likely to have either similar or different land-use patterns and other adaptive behaviors, the survey had to be able to detect and assess these features within their landscape settings.

Archaeological Survey Strategies

The area for survey and its size was, therefore, not predetermined as we proposed; rather, it varied directly according to the logistic considerations. These include the density of archaeological materials found, terrain, and vegetation cover. The more material found, the smaller the survey area; the rougher the terrain, the smaller the survey area; the more dense the vegetation, the smaller the survey area and vice versa.

The actual selection of the survey areas, therefore, was based mainly on inspection of topographic, geologic, and aerial maps. Survey areas were selected on the basis of three primary criteria: 1) areas that represented different geomorphic zones, 2) areas that appeared to offer the best potential for locating archaeological material in relation to eco-zone features, and 3) areas that represented the least difficulties in terms of accessibility. Once a particular area was selected for survey, it was recorded on topographic maps and aerial photographs. Later, it was traced on acetate overlays.

The survey strategy employed was that of systematic surface walkovers. My survey team was composed of six to

seven crew members that were spaced at 3 m intervals; this, nevertheless, varied according to density of archaeological material, terrain, and vegetation cover. In some cases, crew members were spaced as far apart as 5 to 10 m. This, however, was done only in places that offered excellent visibility or where density of archaeological material was low, terrain was even, and vegetation cover was open. In this way, it is unlikely that artifacts were missed during survey. Tape measures and hand-held compasses were used to ensure that the survey transects were 3 or 5 meters apart and parallel, depending on the physical nature of the area.

Augers and shovel testing (0.25 m^2) to find buried archaeological materials and to detect patterns of soil modification were extremely difficult to implement in many of the survey areas because of the immediate underlying bedrock (see Chapter 4). In heavily vegetated areas where systematic surface walk-overs were difficult, surface survey was limited to accessible surface exposures (e.g., trails, stream banks).

As noted earlier, I intended to produce field maps of the surveyed units by using a video camera. I had planned on borrowing a video camera from the Archaeology Unit of the University of Dar es Salaam. However, despite my early request, the camera was not made available to me.

In spite of changing my original survey plans, our field survey strategies successfully identified both high and low density scatters of artifacts, ecofacts and features. Furthermore, the surveyed areas represent all eco- and geo-

zones. I have designated these survey locations as Survey Area: 1, 2, 3, etc. In some instances, dimensions of surveyed areas are only approximations because vegetation cover and landscape configuration precluded more accurate measurements.

Recording System and Data Collection Strategies

During the research our recording strategies also changed as topography, vegetation cover and high density of archaeological materials either prevented or slowed down the implementation of distributional mapping of all recovered artifacts. In addition, in-field distributional mapping of recovered artifacts required attribute analysis of the artifacts before they could be mapped and collected. We realized that our planned recording system required at least three specialized teams: 1) a survey team, 2) an analysis team and 3) a mapping team. The later two teams at least had to be composed of two or more specialists (e.g., lithic analysts) to facilitate the work. Unfortunately, my research team lacked the personnel to do this as there was no other archaeologist with experience in lithic attribute analysis apart from myself. Furthermore, field artifact analysis proved to be much slower and time consuming than was initially thought because of the high density of artifacts. Nevertheless, the distributional recording of artifacts was experimented with at two survey areas, after which it was

abandoned because of time constraints and other logistic reasons mentioned earlier.

In addition, the GPS instrument was unable to receive the satellite transmissions during the day time, possibly because of satellite schedules. Consequently we had to depend on manual instruments to locate our survey units as well as to map the distribution of artifacts in a surveyed area. Unfortunately, mapping the distribution of artifacts by using a manual transit became impracticable as it was very slow, difficult to implement in a rugged terrain, and needed constant clearance of the vegetation cover. Considering all these factors and the limited time, financial resources and specialized personnel we decided not to map the distribution of recovered artifacts.

Instead, localities within selected survey areas with dense scatters of artifacts and bones were gridded in 1 meter square units and the number of artifacts in one selected square was counted. Locations with dense scatters of artifacts were marked on topographic maps and aerial photos. Data were recorded in field notebooks and on survey forms. This included context, geomorphic and environmental setting, size of surveyed area, density of material, presumed archaeological affiliations and future test excavation potential.

A total surface collection strategy was employed only in a selected 1 m^2 unit. In addition, a small representative sample of archaeological material was collected randomly from

each survey area. All other forms of archaeological materials, features and ecofacts were observed, recorded, and left in place.

Excavation Techniques

As noted in Chapter 1, one of the major goals of this research was to assess the potential of the Eyasi Basin for a long-term and multi-disciplinary study of biocultural evolution in East Africa during the Late Quaternary. A necessary development from the surface survey was to investigate this goal through test excavations of selected survey areas. I decided that investigation of selected areas through test excavations would supplement the surface data in providing a better and clearer picture of the dynamics of forager behaviors and cultural capacities responsible for creating the MSA and LSA records in the Eyasi Basin. Given the complimentary nature of excavation and surface material, it should be possible to discern general patterns of land-use between MSA and LSA.

In theory, areas for test excavation would be selected to represent equally all the surveyed eco- and geo-zones. In practice, areas for test excavations could only be chosen where there was a reasonable potential for archaeological deposits.

All excavation proceeded through 10 cm arbitrary levels as natural stratigraphic levels were not apparent. Traditional excavation techniques of trowel and brush were

used, except where we encountered fragile human skeletal remains. Dental picks or sharpened sticks and soft brushes were then used instead of trowels. Each excavation level was assigned its own number (for example, I for excavation level one) and all finds were collected according to these levels. All excavated material was dry-sieved through a 5 mm square wire mesh and all archaeological and palaeontological finds were retained. *In situ* materials were recorded in three dimensions. Sediment samples were taken from each level for later sedimentalogical analysis. Attempts at flotation proved difficult because of water shortage. Stratification, artifacts, features, and additional contextual information were recorded on sketch maps, scale plans, profiles, excavation forms, in detailed field notes and with photographs. Munsell colors were recorded for sediments and arbitrary levels.

Organic samples (charcoal and bone) for ^{14}C dating, and ostrich egg shells and land snail shells for amino acid racemization were, taken when available from stratified context throughout the excavations. A rigorous examination of sample condition, context, and association was made before collecting the sample. Where available, numerous dateable samples were collected from each excavation level so that resulting dates can arrive at useful conclusions. All excavation units were taken down to either sterile soil or bedrock. Excavation was accomplished by a crew of three

workers per unit, supervised by a trained archaeologist, Mr. Richard Mrema, and myself.

In all, six surveyed areas were test excavated. Considerations of the artifacts and other data recovered from survey and test excavations are presented in Chapters 7, 8, and 9.

Ethnographic Inquiries

As previously noted in Chapter 1, the secondary objective of my research was to examine and investigate modern Hadzabe forager's land-use and resource utilization in the Eyasi Basin. I reasoned that identifying the pertinent features that influence present-day Hadzabe forager land-use and resource utilization can provide an opportunity to generate testable hypotheses and develop theoretically and empirically better grounded expectations about the behavioral activities, land-use, and resource utilization patterns of MSA and LSA foragers in the Basin. Accordingly, during my archaeological landscape survey, I also sought ethnographic information on: Why, when, and how do the Hadzabe move across the landscape? Who is involved in the movement? How do Hadzabe perceive their landscape and its resources? What is the Hadzabe sense of the past in terms of attachment to places and things found on the landscape? Such questions were considered in a broad land-use and resource utilization framework.

Interviews and observations were the principal methods used to collect information about Hadzabe land-use and resource utilization.

Interviews. About 100 Hadzabe subjects were interviewed, both formally (structured) and informally. Informal interviews allowed greater breadth of responses. Usually, Hadzabe foragers were interviewed informally when we encountered them either during surveys or at the market place in Mang'ola. Given the nature of Hadzabe mobile lifeways (see Chapter 5), an informal interview was the best technique of data collection concerning Hadzabe land-use and resource utilization. Seventy-five percent of the interviews were collected under informal conditions.

Formal interviews were more planned and were conducted at a number of Hadzabe base camps in the Mang'ola and Masiedha-Siponga areas, and at the Hadzabe villages of Mungo-wa-Mono and Endamaghay (Mang'ola). Appointments were made with the interviewees and the interview questions were known to them in advance. Nonetheless, in most cases, the interviewees seldom kept the appointments, possibly due to conflicting schedules. This interview method was unsuccessful when compared with the informal approach. Some of the formal interviewees were informally interviewed after some days when we met them during surveys. Mr. O. S. Kileo, a trained archaeologist, and my Hadzabe part-time survey crews and consultants (including Maduru Mahiya, Nangay

Makanyange, Kampala Magandula, Matina and Manjano Mahiya) played major roles in collecting Hadzabe ethnographic data.

Observations. We observed the Hadzabe foragers and interacted with them as they moved across the Eyasi landscape over an eight month period. The observations were done during the dry to early wet seasons, from September 1992 to mid February 1993 and August to November 1993. Our observations were, however, not limited to the Hadzabe foragers themselves. As we traversed the landscape during the surveys, we also looked for discarded or lost items of Hadzabe material culture, new and abandoned base camps, and temporary (overnight) camps. My Hadzabe survey crews and in particular my consultant, Maduru Mahiya, were very helpful in identifying items of Hadzabe material culture and new and abandoned camps. The results of the ethnographic inquiries and their archaeological implications have been presented in Chapter 5 and the developed hypotheses are presented in this chapter.

Ecological and Geomorphological Survey

Although the analysis of surface scatters is well suited to large scale studies of human activities in the landscape, it is an inadequate technique for understanding complete patterns of past activities and land-use, if used in isolation. Therefore, analysis and understanding of the ecological and geomorphological processes that influence the archaeological record should form an integral part of field

survey and design. The understanding of biasing and taphonomic processes will allow the full evaluation of a landscape and activities within it.

Correspondingly, during the archaeological survey, I also studied the modern landscape and habitats of the Eyasi Basin to investigate how features of landscape and vegetation, such as the distribution of wild plant foods and rock shelters, affect the ranging behavior and subsistence ecology of Hadzabe foragers. I presumed that these also might have affected the ranging behavior and subsistence ecology of MSA and LSA foragers in similar contexts in the past. With the assistance of our Hadzabe survey crew and consultants, Mr. S. A. Kilindo collected a large sample of Hadzabe plant foods for later scientific identification by a botanist at the University of Dar es Salaam. Unfortunately, this sample was carried away by a flood on the night of December 12, 1992. Without warning, around 1:00 AM, our base camp at the natural springs (locally known as "Kiwanja Gorge") near Gordfani village abruptly flooded due to heavy rainfall in the Oldeani and Karatu highlands. Three of our tents (one of which was for laboratory and specimen storage) were submerged and on the point of sailing off during evacuation. During evacuation, the plastic bag that contained the dried specimens (leaves, berries and tubers) of wild plant foods was washed away. Mr. O. S. Kileo called the flooding disaster the "calamity of the year".

In each surveyed area, we also identified where possible the rock structures and their evolutionary histories. In addition, we observed the geomorphological processes that might have affected the distribution of archaeological materials. Geological trenches for stratigraphic analysis were dug in the northeastern shore of Lake Eyasi. Also, we surveyed the inselbergs and rock cliffs on the eastern side of the lake and the Eyasi Rift Scarps on the western side for evidence of former lake levels. In particular, a geologist, Mr. A. Kweka, was very helpful for the geologic and geomorphologic surveys. The results of the vegetation survey are presented in Chapters 4 and 7, and that of geomorphologic survey in Chapters 4 and 7, while those of plant food distribution are presented in Chapters 4 and 5.

Summary

In this chapter I have discussed the field methods for archaeological survey, data recovery and recording, test excavations, ethnographic inquiries, and geomorphological survey. Also, I have discussed the field logistics and other obstacles that affected my field methods.

In addition, I have generated and formulated ten hypotheses about MSA and LSA forager adaptive behaviors and cultural capacities. Some of these hypotheses will be tested in Chapter 10 with the available archaeological data (see Chapters 7 and 8). I assume that the distributions of archaeological materials across the landscape are the

signatures of the MSA and LSA forager land-use and resource utilization patterns hypothesized in this chapter. Other hypotheses will be tested in the future with new type of research and data (see Chapter 11).

It is important to note that the archaeological record is not my main inspiration in formulating some of hypotheses, but as a test for them. Such hypotheses that are generated independently of the archaeological record are desirable given the limited range of forager activities that leave recognizable traces and the poor temporal and spatial resolutions of the MSA and LSA archaeological record in East Africa (also see Peters and Blumenschine forthcoming). Previously, hypotheses of hominid land-use and resource utilization patterns start with what is known of the location of the "sites" and the structures of the archaeological records, and seeks to interpret the activities conducted at the "sites" in terms of ranging patterns of hominids. Some of my MSA and LSA forager land-use hypotheses concur with "middle range" approaches in being based on the Hadzabe regional analogies, and in seeking to test them by using the regional archaeological record.

CHAPTER 7
FIELDWORK: SURFACE SURVEY

Introduction

In this chapter, I present the results of the surface survey. Accordingly, the chapter will describe the vegetation, geomorphological processes, lithic raw material availability, distributions and affinities of the archaeological materials, and the items of material culture of Hadzabe foragers found in each area selected for survey. It is my hope that the data presented in this chapter will permit a more comprehensive understanding of MSA and LSA forager land-use systems in the Eyasi Basin (see Chapter 10). Furthermore, it will strengthen the culture-history of the Eyasi Basin as described by Mehlman (1989).

Archaeological Survey

A total of 14 survey areas located in several different ecozones and geomorphological features were surveyed. I have designated these survey locations as "Survey Area" 1 to "Survey Area" 14 respectively. As previously noted, the size of survey areas varied from one area to another. Dimensions of survey areas were measured using either a range finder where big trees were present, or 60 m metallic tape measures.

In some instances, dimensions of survey areas are only approximations because spiny, dense vegetation cover, or rough terrain precluded more accurate measurements.

Three characteristics of artifact occurrences are crucial to any surface survey: density of artifacts, 2) type of artifact classes (typology), and 3) associations with which they commonly occur. During field survey, the occurrences of artifacts throughout the selected survey area were observed, studied, and recorded at three levels of density: 1) isolated, 2) low density, and 3) high density artifact scatters.

During field survey (and in this dissertation), sections within the survey area that yielded 0-1 artifact per m^2 were recorded as sections of isolated artifact scatters. Sections that yielded 2-5 artifacts per m^2 were recorded as low density artifact scatters. Sections that yielded more than 5 artifacts per m^2 were recorded as high density artifact scatters. Because of time and financial constraints, only areas of high density artifact scatters are shown on the generated survey maps.

A great deal of attention was paid during field survey to identify the major "cultural stages" the surface artifacts represented. For the Eyasi Basin, these "cultural stages" include the Late Acheulian (e.g., "Sangoan" or "Njarasan" Industry), MSA, LSA, PN, and IA (Iron Age) as identified by Mehlman (1989). For the study of rock art, I adapted the socio-economic framework as defined by Anati (1986) for the

rock art of central Tanzania. The adapted socio-economic stages include the art of the "Bantu", "Hunters", and "Gatherers". However, I must reiterate here that the information presented in this dissertation about the rock art of the Eyasi Basin is preliminary and at most descriptive. A detailed study using a landscape- and ecologically-derived interpretive framework will follow later.

The associations of artifacts of different "cultural stages" and their recovery contexts were given serious field observations and recording. These will be described throughout this Chapter. Detailed descriptions of ecology of each Survey Area is given in Chapter 4.

Survey Area 1

After the inspection of topographic, geologic, and aerial maps, this survey area was selected because the sparse vegetation offered the best potential for locating archaeological materials (see Chapter 6). A survey area measuring about 2.04 km^2 was first defined on topo and aerial maps and later in the field. Survey Area 1 is located in the northeast section of the Eyasi Basin (Figure 7-1) and was 90% surveyed. Three rock outcrops occur and are composed of highly weathered gneiss, granitic gneisses, and mica-schists. Quartz and quartzite dykes of various sizes penetrate these rocks from all directions. Some of them are colored, and others are colorless and transparent.

Survey Area 1 is largely found in the *Acacia-Commiphora* deciduous wooded shrubland. Various kinds of cactus and other succulent plants are also represented. Scatters of baobab trees occur on the slopes of the three rock outcrops. The only game animal observed during the survey was the dik dik. Water from natural springs is available all year round at the western end of the survey area, in Gisimangheda area.

Three localities of high density scatters of stone artifacts occur within the survey area (Figure 7-1). Two of the three localities with high density artifact scatters occur in the eastern end of the survey area. These two localities are two rock shelters and their surroundings, designated as Gordfani 1 and 2 respectively. Dense scatters of stone artifacts, fossilized bone fragments, and pottery were found on the floors, slopes, and surrounding areas of the two shelters. The lithic artifacts found on the surface include cores, core fragments, flakes, hammerstones, hammerstone fragments, and angular fragments. Also, the surface assemblage consisted of a good number of finished tools. These include retouched points, various forms of scrapers, and backed pieces. On the basis of Mehlman's (1989) typology the stone artifacts are characteristic of the "Njarasan" Industry, MSA, and LSA (Figure 7-2; Table 7-1). Many of the artifacts are of quartz material and the hilly outcrops seem to be the sources of raw material. Quartzite, basalt, and obsidian are also represented.

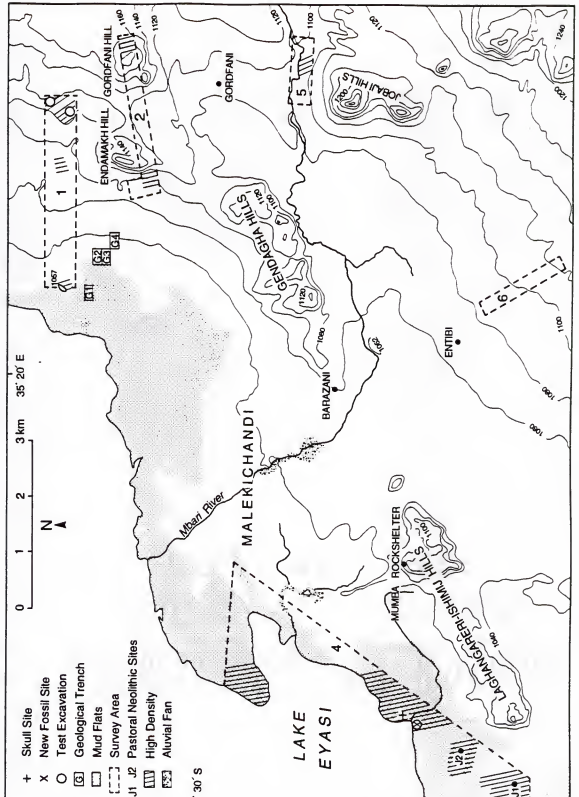


Figure 7-1: Topographic Map Showing Survey Areas 1, 2, 4, 5, and 6.

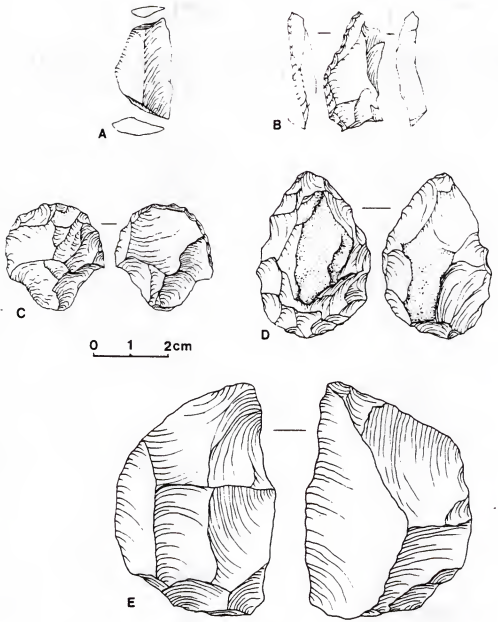


Figure 7-2: Survey Area 1 Stone Artifacts: A, trapez; B, curve-backed piece; C, tanged convex end scraper; D-E, bifaces. Raw Material: A, C, and E, cloudy quartz; B and D, chert.

Table 7-1: Survey Area 1 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed pieces	7	4.64
Scrapers	31	20.53
Becs	3	2.00
Burins	5	3.31
Points	14	9.27
Subtotal	60	39.75
COMPOSITE TOOLS		
Backed and other	1	0.66
Scraper and other	2	1.32
Subtotal	3	1.98
BIFACIALLY MODIFIED PIECES		
Discoids	1	0.66
Point rough-out	1	0.66
Bifacially modified	1	0.66
Subtotal	3	1.98
CORES		
Bipolar	6	4.00
Single platform	2	1.32
Radial	2	1.32
Part-peripheral	3	2.00
Multiple platform	4	2.65
Pyramidal	1	0.66
Opposed double platform	6	4.00
Levallois	1	0.66
Disc	5	3.31
Divers single platform	2	1.32
Amorphous	1	0.66
Subtotal	33	21.90
HEAVY-DUTY TOOLS		
Core scraper	3	2.00
Core chopper	2	1.32
Bifaces	3	2.00
Subtotal	8	5.32
OTHERS		
Utilized flake	7	4.64
Utilized flake fragment	1	0.66
Utilized angular fragment	3	2.00
Blade	1	0.66
Hammerstone	1	0.66
Core fragment	2	1.32
Flake	11	7.28
Flake fragment	2	1.32
Angular fragment	10	6.62
Subtotal	38	25.16
TOTAL	151	100.00

Isolated scatters of potsherds were also found, some of which were in direct association with the microlithic

materials, indicating the presence of both LSA Ceramic and PN cultures. Diagnostic potsherds are few, and these have either rows of punctate or incised lines. The pottery are typical of the LSA's "Kansyore" and PN's "Narosura" Wares in the Basin (Mehlman 1989, personal communication 1992). A large number of ostrich eggshell and snail shell beads were found on the floor of Gordfani 2. Two large pieces of weathered iron bloom were found on the surface 20 m from Gordfani 1, indicating the presence of IA culture. Other material found in this area of high density artifact scatters were ostrich eggshell beads and animal bones. Beads and animal bones were found on the floors and slopes of Gordfani 1 and 2. Faded paintings of animals were observed at Gordfani 1.

Gordfani 1 provides subtle evidence of recent occupation. Burned wood and recent potsherds were found on the floor of this shelter. However, it is Gordfani 2 (located 300 m north of Gordfani 1) that provide clear evidence of recent occupation of the shelter by Hadzabe foragers (see Chapter 5). Hadzabe items of material culture such as a hide, calabash, fire sticks, a bow stick, a pipe fragment, animal skin wallet, three hearths, and an ash place were found on the floor, drip-line, and slope of the shelter. Food debris include bone remains, a maize cob, palm fruit, cow peas, turtle shells, and "magadi" salt from Lake Eyasi. All the recent bones at Gordfani 2 were fresh in weathering stage 1 (Behrensmeyer 1978). Few recent bones were found on

the shelter floor. These were small size fragments. The majority of the recent bones were concentrated on the shelter's drip line and floor. Most of them were large, including cranial, maxillae, mandibular, limb, and vertebral bones and fragments. Also hooves and horns occur. Many of the long limb bones were broken up, possibly to obtain bone marrow. Other bones had cut marks of knife and others had human gnaw marks. Many of the bones were charred possibly due to meat roasting. Our quick count of recent bones in a 100 m^2 unit on the shelter's floor yielded 146 bones. Out of these, 6 were complete and articulated mandibles, 9 complete and disarticulated mandibles, and 6 maxilla fragments. All the recent bones were of small-sized animals (see Chapter 4) of which baboons were over represented. On a daily basis, baboons sleep on the top (about 15 m high) of this shelter and Matina (Hadzabe forager and owner of this shelter) ambushes and kills them easily in the night (Matina personal communication 1992).

Also the survey yielded a pastoral compound that was abandoned ten years ago (Limai personal communication 1992). This compound was circular in structure. Apart from animal dung, domesticated faunal remains, and animal enclosure structures that are characteristic of pastoral homestead, we also found a lower and an upper grinding stones in the abandoned kraal. The lower stone was complete, but the upper was broken and therefore, it was possibly discarded. The complete lower grinding stone was left at the abandoned

homestead possibly because of its heavy weight or the availability of such stones in the new moved in area. Near the abandoned kraal we found scattered disarticulated frontal, parietal, and occipital bones of a young individual. The human skeletal remains exhibited weathering of stage 2 (Behrensmeyer 1978).

The second locality of high density artifact scatters is located c. 500 m west of the two localities described earlier (Figure 7-1). This area measures 15,725 m^2. Water and wind erosion, and cattle trampling have eroded this area, exposing dense scatters of artifacts on the surface. However, the impact of the agents of erosion is not severe as many of the lithic artifacts have unabraded edges. Many of the artifacts were found either on the surface of leveled land or on moderate slopes. Very few artifacts were found in the water rills and gullies that cut through this exposed area.

Because of the lack of dense vegetation cover, the spatial methods of surface survey and recording were practiced. The area was systematically surveyed, and each artifact recovered was flagged. A primary datum point was established at 112 m from the south east corner of the exposed area, along the N-S meridian line and 81 m west. A transit was then set at this datum point and all spatial measurements of recovered artifacts were taken from here. Each recovered artifact was then recorded and analyzed. A total of 5,918 stone artifacts was recovered, recorded, and analyzed. However, because of the density of the artifacts

and a small survey, mapping, and analyzing team, it took almost one and a half months to systematically study this area using the methods of distributional archaeology. Because of time constraints the distributional map of these artifacts will be prepared and published separately.

This area yielded artifacts of MSA affinity and the "Njarasan" Industry (Figure 7-2). These include various types of cores, core scrapers, scrapers, points, becs, and flakes. Also found was a tanged convex end scraper that was probably hafted (J. D. Clark personal communication 1993). In East Africa, similar tanged scrapers have also been found in Uganda (J. D. Clark personal communication 1993). Generally, tanged tools are lacking in the MSA of East Africa, and the few that have been found so far are surface findings. The predominant raw material for the lithic artifacts is quartz although basalt, green phonolite, granite, quartzite, and chert are also represented. Isolated scatters of pyroclastics, volcanic ashes, and concretions were also observed at this area. Neither fossilized bones nor pottery was found at this area of dense artifact scatter. A small sample of the lithic artifacts was collected from the surface.

The third locality of high density artifact scatter occur in the western end of the survey area (Figure 7-1). Various types of cores, backed tools, and flakes of LSA affinity were observed at this area of high density artifact scatters. Only one MSA (MSA/LSA?) artifact, a unifacial

point, was found in direct association with the LSA artifacts. Neither pottery nor animal bones were found. This area was not systematically surveyed as the land is privately owned. The owner was away and we could not get permission to do a thorough survey.

The area between the first and second areas of high density artifact scatters yielded low density scatters of MSA and LSA affinities. Also found were isolated pottery scatters of "Kansyore" and "Narosura" Wares, indicating the use of this surveyed area by both Holocene LSA foragers and PN farmers. All the bones were recent and in various stages of weathering. The area between the second and third areas of high density artifact scatters yielded isolated stone artifacts of MSA and LSA affinities, and pottery of the "Kansyore" and "Narosura" Wares. Recent bones in various stages of weathering were also found.

A small representative sample of about 500 stone artifacts was randomly collected from the surface of Survey Area 1, except the third locality of high density artifact scatters. In addition, a total surface collection of 756 stone artifacts was done from a 4 m^2 unit at Gordfani 1. 12.03% of the surface collection from Survey Area 1 were analyzed (Table 7-1). Shaped tools form 41.06% of the analyzed surface assemblage. The most common category of shaped tools is the scraper, making 50% of all shaped tools from the surface. Sundry scraper and notches are the most common scraper types, each making 14.29% of all scrapers.

The second most common category of shaped tools is the points, making 22.58% of all shaped tools. The unifacial point is the most common, making 85.71% of all points. Backed tools form 11.29% of all shaped tools and the curve-backed piece is the most common type of all backed tools. Burins are few, making 8.06% of all shaped tools. Angle burin is the most common burin type. Becs form 4.84% of all shaped tools and composite tools form only 3.23%.

Bifacially modified pieces form 2% of the surface assemblage and the heavy-duty toolkit make 5.30%. Cores form 24.50% of the surface assemblage. Bipolar and opposed double platform cores are the most common, each forming 16.22% of all cores. The disc core is the second most common type (13.51%) followed by the multiple platform core (10.81%). Other represented cores include the levallois, pyramidal, radial, etc., (Table 7-1).

Survey Area 2

This area was selected after the examination of topo, geologic, and aerial maps. We reasoned that the two hills occurring in this survey area would have been important in prehistoric times not only as sources of lithic raw materials, but also as points for game lookouts. Survey Area 2 covers 0.92 km^2, from the top of Gordfani Hill to the western slopes of Endamakh Hills (Figure 7-1). The hills are composed primarily of highly weathered gneissic rocks that are sometimes intruded by quartz and micacious dykes.

Volcanic gravels and pyroclasts are common features in this survey area.

Survey area 2 is covered by open thorny and spinous thickets that gradually become dense in the western and southern slopes of Gordfani hill. Scatters of short trees are found at the foot of the slopes. Various species of cactus plants and the wild sisal (oldupai) also are found in this area. Baobab trees are scattered on the slopes and the plain that surround the hills. Also found are isolated trees of *Cordia sinensis* and *Salvadora persica*. The only game animal found during the survey was a dik dik. Water is available all year round at the nearby natural springs, a distance of about two km.

Survey Area 2 was 85% covered by a systematic survey of 54 transects. The archaeological visibility was good except the western and southern foots of Gordfani Hill. Nonetheless, vegetation cover and the terrain structure did not permit the recording and mapping of the spatial distribution of artifacts. High density scatters of lithic artifacts were found on two locations: on top of and the eastern slope of Gordfani Hill and on the western slopes of Endamakh Hills (Figure 7-1). The two dense scatters on Gordfani Hill were separated from each other by a distance of 15 m of low density artifact scatters.

The dense scatter on top of Gordfani Hill measures 3,120 m^2. The artifacts occur in a small triangular facet that can best be described as an artifact-trap landform. Nonetheless,

the distribution of artifacts goes beyond this area, toward the southeastern slope. This dense scatter is composed primarily of large-cores, and flakes of the "Njarasan" Industry. These were mixed up with large-cutting and chopping tools of the "Njarasan" Industry, angular fragments, and unmodified quartz, quartzite, basalt, and granite nodules (raw materials).

The dense scatter on the eastern slope covered an area of about 2,964 m^2. Thousands of stone artifacts are littered on this gentle slope. The lithic artifacts are essentially composed of tools, cores, and flakes of both MSA and LSA traditions. Angular fragments, however, predominate and pottery remains were not found.

The dense scatters of lithic artifacts on the western slope of Endamakh Hills had artifacts that were heavily abraded. It appears that geomorphological (fluvial-colluvial) processes has substantially reworked the lithic artifacts on this section of the survey area. Nevertheless, the majority of the artifacts have sharp edges, suggesting that they have not been heavily rolled down by fluvial processes. It appeared that the lithic materials were eroding from the top of the hill. Nonetheless, our survey on the top of the hill yielded no dense scatters. Tools, cores, and flakes of both MSA and LSA traditions are represented at this high density scatter.

Low density scatters were found on the foot of Gordfani Hill and on the western slope of Endamakh Hills. However,

the large part of the survey area had artifacts distributed as isolated scatters. Overall, this survey area yielded

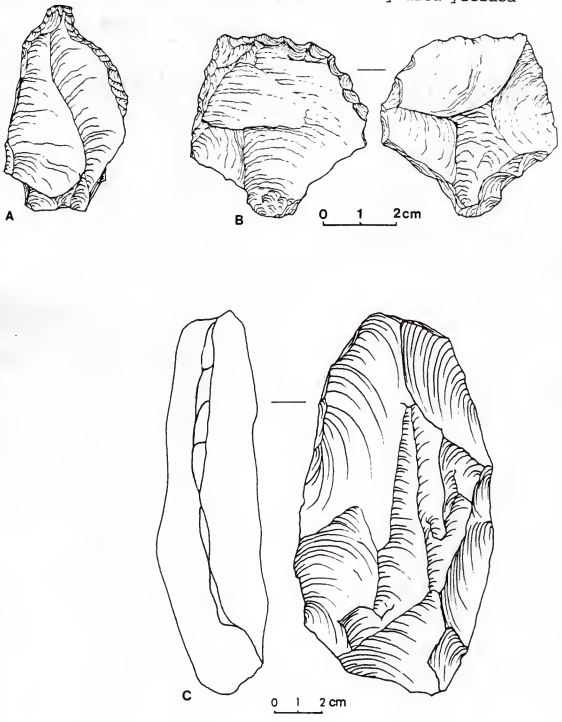


Figure 7-3: Survey Area 2 Stone Artifacts: A, nosed end scraper; B, convex end scraper; C, diminutive handaxe. Raw Material: all cloudy quartz.

lithic materials of "Njarasan", MSA, and LSA cultural traditions (Figure 7-3). More often, artifacts of MSA and LSA were found mixed together. Lithic artifacts of the "Njarasan" Industry were found on top of Gordfani Hill where they were mixed together with lithic assemblages of the MSA. Isolated, undiagnostic potsherds were found on the eastern slope of Endamakh Hills. However, their occurrences in this survey area also suggests its utilization by either Holocene LSA foragers, PN farmers, or both. Isolated scatters of recent animal bones were observed throughout the survey area. Neither fossilized bones nor Hadzabe items of material culture were found in Survey Area 2. However, the lack of Hadzabe items of material culture should not imply that Hadzabe foragers do not utilize this area as we observed Hadzabe foragers passing through this area during our research.

There are numerous naturally eroding quartz scatters throughout this survey area. High density scatters of naturally occurring quartz were present on the Gordfani hilltop and on the western slope of Endamakh Hills. This naturally occurring quartz could be considered potential raw material sources for MSA and LSA foragers. Interestingly, the Gordfani Hill is still a source of raw materials for grinding stones. Despite that this area of the Eyasi Basin had four motor grain grinding machines during our research, some Iraqw and Mang'ati pastoralists and agropastoralists and Hadzabe foragers are still using grinding stones to grind

their grains. This is because, pastoral and agropastoral people who, because of large herds of cattle prefer to live away from nearby villages that have motor grinding machines. According to our informants, Gordfani hill is the major quarry site for grinding stones in Mang'ola area. During our survey, we observed and documented quarrying and processing of a grinding stone by a Mang'ati agropastoral woman at Gordfani hill.

Table 7-2: Survey Area 2 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Scrapers	5	9.26
Burins	1	1.90
Points	2	3.70
Subtotal	8	14.86
BIFACIALLY MODIFIED PIECES		
Cutting edge	1	1.90
CORES		
Bipolar	1	1.90
Single platform	1	1.90
Radial	5	9.30
Opposed double platform	2	3.70
Disc	3	5.60
Amorphous	1	1.90
Subtotal	13	24.30
HEAVY-DUTY TOOLS		
Core scraper	3	5.60
Bifaces/picks	4	7.40
Core-axe	2	3.70
Subtotal	9	16.70
OTHERS		
Utilized flake	4	7.40
Utilized flake fragment	1	1.90
Utilized angular fragment	1	1.90
Blade	1	1.90
Flake	9	16.70
Flake fragment	1	1.90
Angular fragment	6	11.10
Subtotal	23	42.80
TOTAL	54	100.00

A small sample of about 100 stone artifacts was randomly collected from the survey area. A total surface collection

of 432 stone artifacts was undertaken from a 1 m^2 unit on the eastern slope of Gordfani Hill. About 85% of the artifacts collected from the 1 m^2 unit were angular fragments. About 10% of the collected surface assemblage was typologically analyzed and the results are presented in Table 7-2.

Survey Area 3

This survey area is located on a ridge that borders the Mbarai River in the south in "Kambi ya Mkaa" area (Figure 7-4). The vegetation type is transitional from Acacia-Commiphora deciduous wooded shrubland on the ridge to Somalia-Maasai woodland on the flood plains of the Mbarai River. During the dry season, potable water is dug out in the Mbarai River bed. The Mbarai River flood plain in the "Kambi ya Mkaa" area is very rich in plant food resources (see Chapters 4 and 5).

This area was selected for survey because of the ecological and landform potentials the ridge would have offered in prehistoric times for forager survival. Survey Area 3 measures 0.1 km^2 and was 100% surveyed by a team of 7 people placed at 5 m intervals. A total of 40 transects were surveyed. All the recovered artifacts were first flagged and then analyzed. The spatial distribution of artifacts was recorded by a transit that was moved at several points. This survey area yielded isolated artifact scatters. A total of 900 stone artifacts was recorded and mapped.

Figure 7-4: Topographic Map Showing Survey Area 3.

The archaeological material recovered at this area include diminutive handaxes, bifaces, cores, scrapers, backed pieces, and flakes, some of which are very large (Figure 7-5). On the basis of Mehlman (1989) the lithic material of this survey area can broadly be considered to include the "Njarasan" Industry, MSA, and late Pleistocene LSA. The other items of material culture found at this area apart from stone artifacts were a stone cairn burial and a Hadzabe rusted metal arrow head.

The predominant raw material at this survey area is volcanic lava. All the diminutive handaxes, bifaces, and large flakes are made of olivine basalt. Dense scatters of basalt cobble and gravels are found at Survey Area 3. Almost all the olivine basalt artifacts are highly abraded. However, since these artifacts are found on the slopes near the ridge top, the actions of water as the cause of such abrasions is ruled out. Instead, I see that the olivine basalt artifacts have undergone severe weathering actions. The olivine basalt is from the Oldeani Mountain that lie north of this survey area. Mount Oldeani olivine basalt is composed of pyroxene or augite crystals. Weathering has worn these basalts and single crystals of pyroxene are found on the surface at Survey Area 3 and nearby areas. Few artifacts of quartz, quartzite, chert, and obsidian raw materials were also found. A sample of about 56 stone artifacts was randomly collected from the surface. About 32% of the collected surface artifacts were typologically analyzed

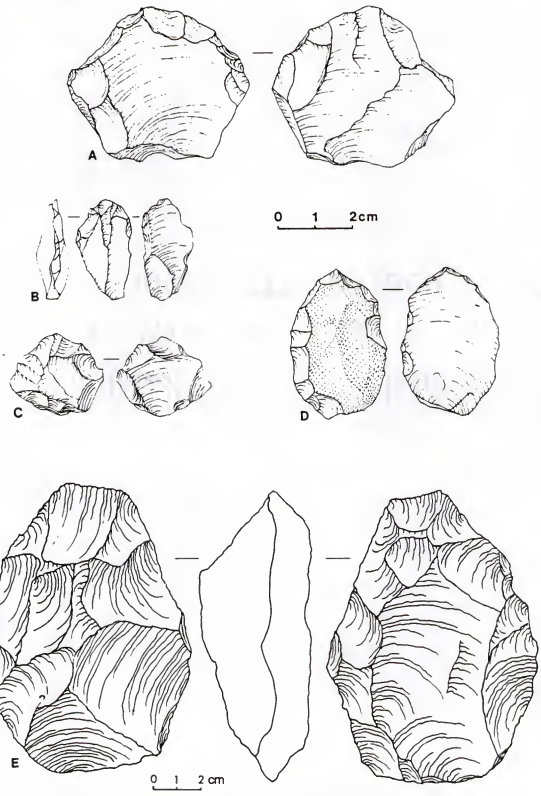


Figure 7-5: Survey Area 3 Stone Artifacts: A, core scraper; B, bipolar core; C, divers backed; D, convex end and side scraper; E, diminutive handaxe. Raw Material: A, B, and D, chert; C and E, cloudy quartz.

and the results are presented in Table 7-3.

Table 7-3: Survey Area 3 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	2	11.11
Scrapers	2	11.11
Points	1	5.60
Subtotal	5	27.82
CORES		
Radial	1	5.60
Levallois	1	5.60
Subtotal	2	11.20
HEAVY-DUTY TOOLS		
Core scraper	3	16.70
Bifaces/picks	1	5.60
Dimunitive handaxe	1	5.60
Subtotal	5	27.90
OTHERS		
Utilized flake fragment	1	5.60
Utilized blade segment	1	5.60
Scraper fragment	3	16.70
Angular fragment	1	5.60
Subtotal	6	33.50
TOTAL	18	100.00

Survey Area 4

One of the major goals of this research project was to recover hominid fossil remains that will increase the size and quality of the African hominid fossil sample for the Middle and Late Pleistocene. The rarity of hominid fossils in East Africa dating to this span limits our understanding of a period crucial to the evolution of our own sub-species.

This survey area was selected for surface survey because on the basis of the available information (e.g., Mehlman 1989) it offered the best potential for recovering additional hominid remains. A survey area measuring about 4.13 km^2 was first defined, recorded on aerial and topo maps, and later

traced on acetate overlay. Survey Area 4 is located on the salt flats along the lakeshore (Figure 7-1). Here, there is little or no vegetation due to the soda and salt of Lake Eyasi.

Systematic surface walkover was then conducted by seven crew members spaced at 7 m interval. Since the terrain was flat and open, the surface walkover covered 100% of the area. Survey Area 4 offered excellent visibility and it is unlikely that artifacts and faunal remains were missed. A total of 107 survey transect, were defined using a Brunton compass and then surveyed.

The survey found four locations yielding high density scatters of artifacts and fauna remains. The first to be described here is a 1 km^2 area that yielded stone artifacts, fossilized bones of fish, hippo, and small and large bovids. The fossilized bones were highly mineralized and black in color. Recent bones of small bovids, fish, and birds in various stages of weathering were also found. Moreover, a hominid cranial fragment was found on a gentle sloping surface of a small sand dune or hummock and in close association with other fossilized and highly fragmented bones. This locality is the Skull Site where Kohl-Larsen found the other three Lake Eyasi hominid crania in the 1930s (Figure 7-1). The occipital fragment belongs to a fourth individual of Lake Eyasi "archaic" *Homo sapiens*. A descriptive account and analysis of this newly found fossil hominid is in preparation (Bräuer and Mabulla forthcoming).

Intensive surface examination of all bone fragments within a 2,000 m^2 area of the hominid fossil finding failed to recover more hominid remains. Heavy-duty cutting and chopping tools of the "Njarasan" Industry were found in direct association with many fragmented faunal remains. All the fossilized faunal remains (including hominid) and artifacts were found on the surface, loosely resting on a dark gray clay underlain by patches of consolidated red or pale red clay or claystone.

Another locality with high density scatters of fossilized bones and stone artifacts were found about 5-6 km northeast of the Skull Site (Figure 7-1). This area is probably within the Nordostbucht (northeast bay) of Kohl-Larsen (see Mehlman 1989). Two hominid mandibles were recovered from the surface in the 1960s; one by C. A. Keilland and the other by Ikeda (see Mehlman 1989). Keilland's and Ikeda's hominid mandibles were most likely found in this area of high density scatters of bone and artifacts of the "Njarasan" Industry. Unfortunately, full description and analysis of the hominid mandibles are not forthcoming. Moreover, our survey failed to recover additional fossil hominid remains from this locality.

The other two localities with high density scatters of cultural materials are two PN sites. These PN settlements were discovered in the 1930s by Kohl-Larsen, and they are recorded as Jangwani I and II by Mehlman (1989; Figure 7-1). Large compositions of "Narosura" Ware in direct association

with faunal remains of domesticated animals and a lithic assemblage of the "Ishimijega" Industry was observed at both localities (see also Mehlman 1989). The pottery ranged from 0.5 cm to 1.7 cm in thickness. Jangwani I covers an area of about 22,500 m^2. Jangwani II is possibly an archaeological midden rising up to about 15 m above the modern lake shore (see also Mehlman 1989). No excavation has been conducted at this important archaeological feature.

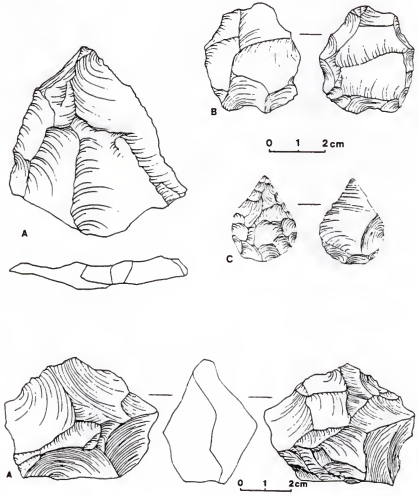


Figure 7-6: Survey Area 4 Stone Artifacts: A, Levallois flake; B, disc core; C, unifacial point. Raw Material: A, phonolite; B, chert; C, cloudy quartz.

The density of the lithic artifacts, fossilized bones, and pottery between the described high density patches ranged from low density to isolated scatters. MSA and late Pleistocene LSA stone artifacts were found in these areas of low density to isolated artifact scatters. Overall, this survey area has yielded archaeological materials of both "Njarasan", MSA, late Pleistocene LSA, and Holocene LSA (?) foragers and PN farmers (Figure 7-6). Since the artifacts from this survey area have been fully described by Mehlman (1989), only a small sample of 25 stone artifacts were randomly collected from the surface. About 60% of collected artifacts were analyzed and the results are presented in Table 7-4.

Table 7-4: Survey Area 4 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Scrapers	3	20.00
Points	1	6.70
Subtotal	4	26.70
CORES		
Disc	1	6.70
OTHERS		
Flake	8	53.30
Levallois flake	2	13.30
Subtotal	10	66.60
TOTAL	18	100.00

Survey Area 5

Survey Area 5 is found south of Gordfani village and east of the bridge that cross the Mbarai River on the Gordfani/ Entii (NT) road (Figure 7-1). The survey area includes the Mbarai River bed, cut banks, and the surrounding

northern and southern areas; measuring about 0.94 km^2 (Figure 7-1). This area was selected for survey because it represented a riverine eco-zone. The area would have been important for forager survival in prehistoric times during the dry seasons as water could have been dug from the river bed. The margins of the river course belong to the Somalia-Maasai woodland type of vegetation. However, the vegetation changes abruptly to Acacia-Commiphora deciduous wooded shrubland 15-20 m away from the river course. During the survey the river was dry. In the survey area, we come across many scatters of small animal droppings, suggesting that dik dik and antelopes were present in this area.

Since we expected to find artifacts embedded on the bed and in the cut banks of the river we conducted a systematic survey covering 100% of the river bed and its cut banks. A survey team of 3 crew members spaced at 5 m intervals surveyed the river bed. The river is about 14 m wide and 7 m deep at this area. Four crew members surveyed the cut banks, two on each side. Nonetheless, neither the river bed nor the cut banks yielded any archaeological material.

Seven transects of 5 m intervals and covering 80% of the area were run parallel to the river course on each side of the river. A high density artifact scatter was found on the southern side of the river (Figure 7-1). The remaining part of the southern side of the river yielded isolated to low density artifact scatters. The northern side of the river yielded isolated scatters of artifacts. The recovered

artifacts of Survey Area 5 include radial, levallois, and disc cores, core scrapers, various forms of scrapers, large flakes, and angular fragments. Typologically this surface assemblage shows the characteristics of both "Njarasan", MSA, and late Pleistocene LSA cultural stages (Figure 7-9). Neither Holocene LSA nor PN materials and/ or features were found. The few bones that we found were recent and in various stages of weathering. The only feature we found at this survey area was two Hadzabe simply constructed branch huts on top of the southern river bank. Both huts had a hearth, one of which had a burning fire. Few fresh bones of birds were found at the hut with a burning fire. No other items of material culture were found at these two huts that would have enabled us to identify the cultural affinity of their occupants. However, our informants (foragers and farmers) identified the two huts as Hadzabe overnight camps. The view that the two huts are overnight camps is supported by the few bones found at the huts and the general lack of items of material culture.

The surface lithic assemblage is predominantly a quartz assemblage with few occurrences of quartzite, chert, and basalt raw materials. The artifacts at the density artifact scatter on the southern margin of the river were in direct association with numerous naturally occurring raw materials. These are quartz and quartzite that occur naturally as blocks throughout the surveyed area and beyond, extending as far as to Mount Jobaji. No lithic raw material in the form of

either quartz pebbles or cobbles were found on the river floor and cut banks. A small sample of about 165 stone artifacts were randomly collected from the surface. About 28% of the collected artifacts were analyzed (Table 7-5).

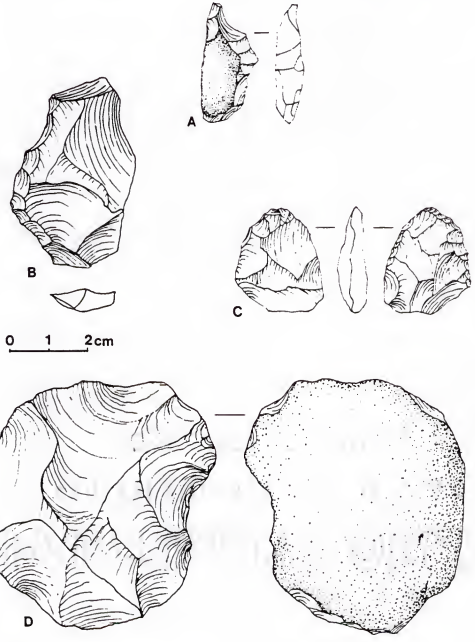


Figure 7-7: Survey Area 5 Stone Artifacts: A, backed fragment; B, convex side scraper; C, biface; D, disc core. Raw Material: A and C, chert; B, quartzite, D, cloudy quartz.

Table 7-5: Survey Area 5 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	2	4.30
Scraper	4	8.80
Point	5	10.80
Bec	1	2.20
Subtotal	12	26.10
CORES		
Pyramidal	1	2.20
Single platform	1	2.20
Opposed double platform	2	4.30
Divers single platform	1	2.20
Levallois	2	4.30
Disc	8	17.40
Multiple	1	2.20
Subtotal	16	34.80
HEAVY-DUTY TOOLS		
Biface/pick	1	2.20
Core-axe	1	2.20
Subtotal	2	4.40
OTHERS		
Blade	1	2.20
Flake	11	23.90
Flake fragment	1	2.20
Core on flake	1	2.20
Angular fragment	2	4.60
Subtotal	16	35.10
TOTAL	46	100.00

Survey Area 6

This survey area is located south of Entii or N. T. (National Treasury) village (Figure 7-1). The area lies in the Acacia-Commiphora deciduous wooded shrubland type of vegetation and the land is flat. *Cordia gharaf* and *Salvadora persica* trees were scattered throughout the survey area. Baobab trees occur south of the survey area on the eastern foot slopes of the Kidero Horst. Rare dik dik and antelopes were found in this area.

Survey Area 6 measures 0.40 km^2. It was selected for survey because it offered a good archaeological visibility

due to the sparse vegetation. The area was surveyed by a team of seven crew members placed at 5 m intervals. A total of 50 walkover transects were surveyed, covering 100% of the survey area. The southern portion of the survey area is cut by numerous streams that form shallow gullies. Few MSA artifacts were found eroding from the edges of these streams.

Low density artifact scatters in direct association with cobbles were found south of the survey area near the foothill. With the exception of this section, generally the survey area had isolated artifact scatters. Both MSA and LSA artifacts were found. Quartz that occurs naturally on the hill slopes and exposed cobbles and stream pebbles is the most common used lithic raw material.

Table 7-6: Survey Area 6 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	4	12.12
Scraper	2	6.10
Point	3	9.10
Subtotal	9	27.32
CORES		
Single platform	1	3.03
Opposed double platform	3	9.10
Radial	1	3.03
Disc	1	3.03
Multiple	2	6.10
Bipolar	1	3.03
Subtotal	9	27.32
OTHERS		
Flake	6	18.20
Utilized flake	3	9.10
Flake fragment	2	6.10
Core fragment	2	6.10
Angular fragment	2	6.10
Subtotal	15	45.60
TOTAL	33	100.00

Isolated recent bones in stage one and two of weathering were found scattered throughout the survey area, especially,

in the northern half. One burial cairn was found in this area. Also the survey yielded isolated scatters of undiagnostic prehistoric pottery. Low density scatters of recent pottery were found near two pastoral homesteads that were occupied at the time of survey. About 83 stone artifacts were randomly collected from the surface. About 40% of the collected artifacts were analyzed and their types are presented in Table 7-6.

Survey Area 7

This survey area runs northwest from the foothills that overlook Lake Eyasi to the granitic outcrops near the lake shore (Figure 7-8). The area with the granitic outcrops or inselbergs near the lake shore is locally known as Mumba and is here referred as "Mumba Proper" to distinguish it from Mumba Rock Shelter located north of here. This location is also known as "Kambi ya Samaki" where fishermen camp and dry their fish when the water level of Lake Eyasi is high. Survey Area 7 is located in the Acacia-Commiphora deciduous wooded shrubland. *Cordia gharaf*, *Salvadora persica*, and baobab trees occur here and there. The terrain is extremely flat when approaching the lake shore. This area was selected for survey because it offered an optimal archaeological visibility. Also the granitic outcrops offered an opportunity for discovering rock paintings.

Survey Area 7 measures 2.40 km^2. A systematic transect survey was conducted by a team of seven people placed at 5 m

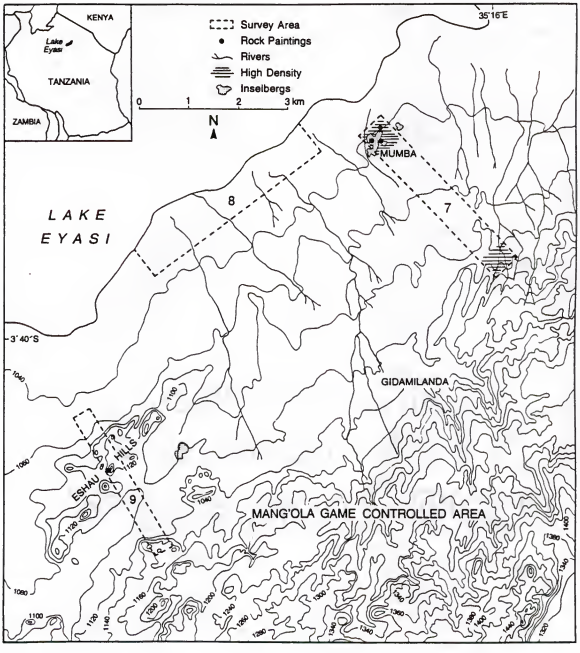


Figure 7-8: Topographic Map Showing Survey Areas 7, 8, and 9.

intervals, covering 100% of the area. About 100 transects were systematically surveyed. Two locations with high density artifact scatters were found. First, is the southeastern end of the survey area, near the quartzo-granitic outcrops (Figure 7-8). Here stone artifacts of "Njarasan", MSA, and LSA cultural stages were found on the surface in direct association. Second, is the "Mumba Proper" rocky outcrops. High density scatters of MSA, LSA, and PN cultural stages were found eroding from the slopes of the quartzo-granitic outcrops (Figure 7-9). The area between the two high density artifact scatters yielded isolated artifact scatters.

Fossilized bones were found at the "Mumba Proper" rocky outcrops. Recent bones in weathering stage one to two occur in the survey area as isolate scatters. Also found were isolated scatters of "Kansyore" and "Narusora" Wares, in particular, around "Mumba Proper" rocky outcrops. A small sample of about 105 stone artifacts was collected from the surface. About 55% of the collected artifacts were typologically analyzed and the results are presented in Table 7-7.

Two rock shelters and a cave at "Mumba Proper" inselbergs have prehistoric paintings. These are "Mumba Proper" 1, 2, and 3. Our preliminary observations of individual rock paintings in the Eyasi Basin indicated a wide diversity of activity and perceptions that existed in terms of forager social, economic, and religious activities.

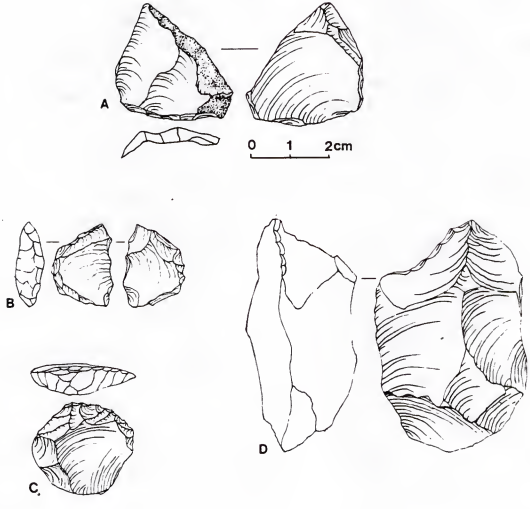


Figure 7-9: Survey Area 7 Stone Artifacts: A, Levallois core; B, crescent; C, convex end and side scraper; D, core scraper. Raw Material: A and C, chert; B and D, cloudy quartz.

Table 7-7: Survey Area 7 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	3	5.36
Scraper	9	16.10
Point	4	7.14
Burin	1	1.80
Denticulate	1	1.80
Subtotal	18	32.20
COMPOSITE TOOLS		
Scraper and other	1	1.80
BIFACIALLY MODIFIED PIECES		
Point rough-out	1	1.80
HEAVY-DUTY TOOLS		
Core scraper	4	7.14
Biface/pick	5	9.00
Subtotal	9	16.14
CORES		
Part-peripheral	1	1.80
Divers single platform	1	1.80
Opposed double platform	2	3.60
Radial	1	1.80
Disc	5	9.00
Levallois	1	1.80
Multiple	2	3.60
Bipolar	5	9.00
Single platform	1	1.80
Subtotal	19	34.20
OTHERS		
Flake	2	3.60
Utilized flake	3	5.36
Core fragment	1	1.80
Angular fragment	2	3.60
Subtotal	8	14.36
TOTAL	56	100.00

"Mumba Proper" 1. This is a straight-faced shelter with a dirt floor that is about 36 m^2. The shelter faces to the west. A panel of fishing scenes (e.g., human figures depicted fishing) predominates. Other paintings depict fish-like creatures. The paintings are in various shades of red. More than 10 paintings occur on the shelter wall in an area of about 14.88 m^2.

"Mumba Proper" 2. This is a small cave that face to the east and without a dirt floor. The cave floor occur about 1.40 m above the ground. Only one filled-in painting of an elephant was found on the roof of the cave. The painting is in red color.

"Mumba Proper" 3. This is an overhang shelter with a dirt floor. The shelter has a panel of possibly a dancing scene(?) with 12 people depicted standing, each holding the hand of the next fellow. Two giraffes are depicted at the far right end of the shelter wall, away from the human figures. All the paintings are represented in a naturalistic form. Some of them are in motion while others are in motionless. The color of the paintings as per Munsell Soil Color Chart is red. The preservation condition of the paintings is poor because of painting weathering due to environmental factors (Mabulla 1996).

Survey Area 8

Survey Area 8 is located on the salt flats of Lake Eyasi (Figure 7-8) where vegetation is lacking. This survey area measures 3.20 km^2. This area was 100% surveyed by a team of seven crew members placed at 7 m interval. The survey yielded virtually no surface archaeological material. The survey area is covered by deposits of recent alluvium. The lack of artifacts on the surface may be attributed to the burial and redeposition of material that occur comparatively

rapid here. Only isolated scatters of recent large pieces of animal bones were, however, found.

Survey Area 9

This survey area cuts through the Eshau Hills located south east of Survey Area 8 (Figure 7-8). A large part of the survey area lies within the Acacia-Commiphora deciduous bushland and thicket. Isolated scatters of baobab trees and other edible plants occur. Small groups of antelopes were observed on the lake flats that overlook this survey area.

The survey area was about 1.3 km^2. Although a systematic transect survey with crew members placed at 5 m interval was practiced, it was difficult to follow the defined transects because of the rocky terrain. Only 50% of the area was surveyed. This may have affected our artifact recovery as some areas were practically impossible to reach. Nevertheless, artifact density ranged from low density around the rocky outcrops to isolated scatters on the flat areas. Both MSA and LSA artifacts were found, but no surface collection was undertaken. One rock shelter has a few fading paintings in various shades of red. The depicted animals and humans are in a naturalistic style.

Survey Area 10

This area is located in the hills of the Kidero Horst, southwest of Endanyawishi Village (Figure 7-10), representing different geomorphic- and eco-zones. The vegetation type is

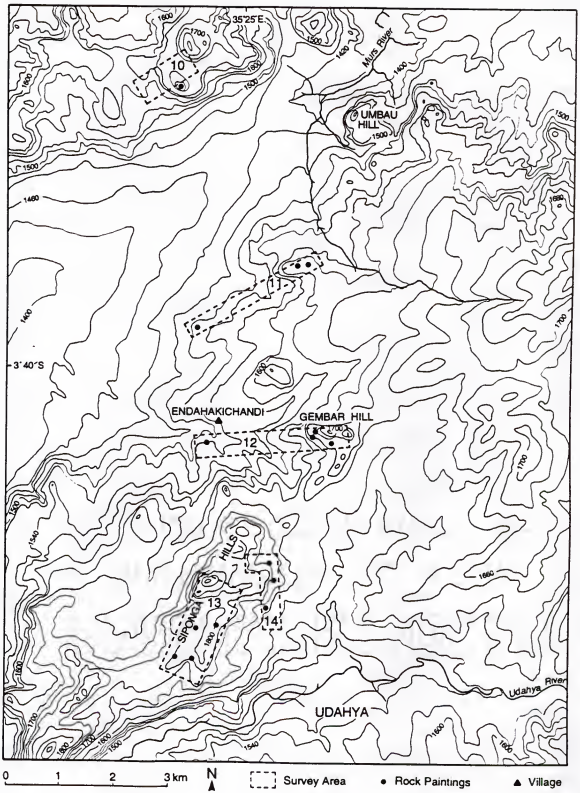


Figure 7-10: Topographic Map Showing Survey Areas 10, 11, 12, 13, and 14.

predominantly Acacia-Commiphora deciduous bushland and thicket. High density scatters of fruit trees of different species with dried fruits occurred during the survey. Our Hadzabe crews introduced these dried fruits to us which we snacked them throughout the survey of this area. Few residents small and medium-sized game animals were found in this area during the late dry season. The elephant and giraffe dung that we found in this area suggest that large games are available during the wet season.

Survey Area 10 covers 0.625 km^2 and about 80% of it was surveyed. High density artifact scatters were found on the slopes of inselbergs and rock shelters that characterize this survey area. Moving away from these inselbergs and rock shelters, the density of artifacts decreased in a gradual manner, from high to low density to isolated scatters. However, many of the rock shelter floors have low density to isolated artifact scatters. Both MSA, LSA, and PN artifacts occur in the area (Figure 7-11). At the floor of one rock shelter, stone artifacts possibly Holocene LSA or PN were found in direct association with undiagnostic pottery, sub-fossilized bone fragments, and ostrich eggshells. A small sample of about 140 stone artifacts were randomly collected from the surface. About 46% of the collected artifacts were typologically analyzed (Table 7-8).

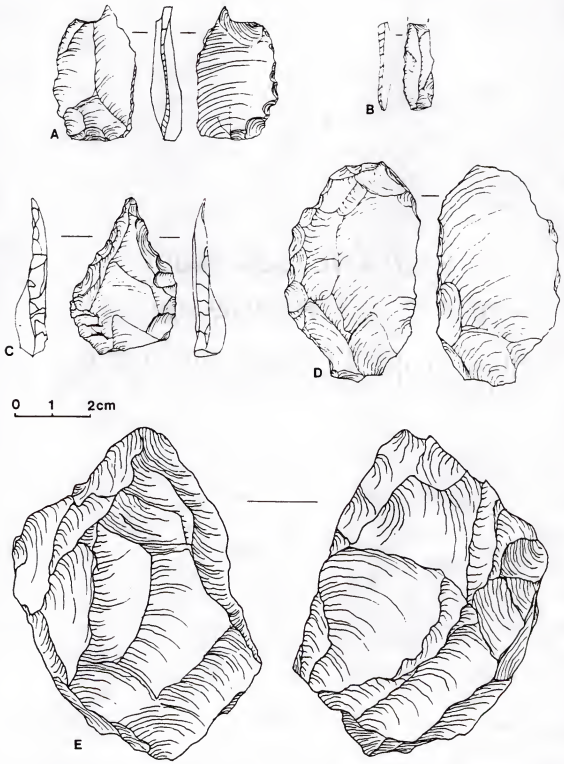


Figure 7-11: Survey Area 10 Stone Artifacts: A, dihedral burin; B, straight-backed piece; C, Levallois point; D, convex end and side scraper; E, radial core. Raw Material: A, obsidian; B-C, chert; D-E, cloudy quartz.

Figure 7-8: Survey Area 10 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	6	9.00
Scraper	11	16.42
Point	6	9.00
Burin	2	3.00
Bec	1	1.50
Outil écaillé	2	3.00
Denticulate	1	1.50
Subtotal	29	43.42
COMPOSITE TOOLS		
Scraper and other	1	1.50
HEAVY-DUTY TOOLS		
Core scraper	1	1.50
CORES		
Part-peripheral	2	3.00
Pyramidal	1	1.50
Opposed double platform	3	4.50
Disc	2	3.00
Bipolar	1	1.50
Single platform	1	1.50
Subtotal	10	15.00
OTHERS		
Levallois flake	2	3.00
Flake	10	15.00
Utilized flake	7	10.50
Core fragment	1	1.50
Blade fragment	1	1.50
Scraper fragment	3	4.50
Angular fragment	2	3.00
Subtotal	26	39.00
TOTAL	67	100.00

Two rock shelters were found to have rock art. These are Kiserenge 1 and 2.

Kiserenge 1. This is an overhang shelter. The paintings cover an area of 18 m^2 of the rock face. At this shelter a panel of a hunting scene is evidenced by human figures holding bow and arrows aimed at an elephant. Other depicted subject matters include an ostrich and a lion.

All the paintings are in naturalistic style, with few in motion. The color of the paintings ranges from dark brown to red.

The presence of ash places, charcoal fragments, a wooden spatula, and baobab husks at the floor of this shelter suggests its recent occupation by Hadzabe foragers. Indeed, this indication was confirmed by our Hadzabe informants. Kaserenge 1 was occupied by a Hadzabe man between February and May 1991.

Kaserenge 2. This shelter is located 200 m northwest of Kaserenge 1. On the basis of style, color, and subject matters at least two painting phases are represented. The earliest painting is a human figure in red color. This is depicted dancing and is drawn in fine lines. The latest paintings are in ashy or latex white colors, commonly known as "dirt white" (Anati 1986). Geometric is the only subject matter. This includes rectangles, dots, tallies, and solar shapes drawn in thick lines by finger point stencil. These are superimposed on top of the human figure. On the basis of subject matter and painting style, these later paintings are characteristic of the art of the "Bantu".

Survey Area 11

This survey area is located on the northeastern margin of the Yaeda-Endanyawishi Graben (Figure 7-10). The terrain is dominated by rocky outcrops and small hills. Few stream channels or "gullies" were found. The area was selected for

survey because of the need to find evidence of rock shelter utilization by prehistoric and modern foragers.

The vegetation cover is Acacia-Commiphora deciduous bushland and thicket. Although the vegetation was dry, our Hadzabe informants identified to us several edible tuber and root plant foods. Like Survey Area 10, this survey area also was rich in dried bush fruits that we snacked on during our survey. Interestingly, we observed many Iraqw and Mang'ati herdsmen and herdsboy also snacking on dried bush fruits. Small groups of resident antelopes, wild pigs, giraffes, and elands occurred to the west of the survey area in the Acacia-Commiphora deciduous wooded shrubland that fringes the Yaeda-Endanyawishi Graben. A leopard that was come across by one of us during survey, is the only large carnivore we came across in the Eyasi Basin during our research.

Survey Area 11 covers 0.69 km^2. Systematic transect survey of this area was hampered by the rocky terrain and the bushland thicket. On relatively open spots, systematic transect survey was conducted. However, a large part of the area was randomly surveyed, with crew members following animal trails. Occasionally, crew members had to crawl through the spinuous bushes and thickets. Because of the dense bushland and thicket vegetation cover, only 50% of the area could be surveyed.

High density artifact scatters were found on the slopes of inselbergs and shelters. For instance, a high density artifact scatter at the slope of one rock shelter measured

59.2 m^2. A total of 165 stone artifacts were collected from a 1 m^2 unit placed at this area of high density artifact

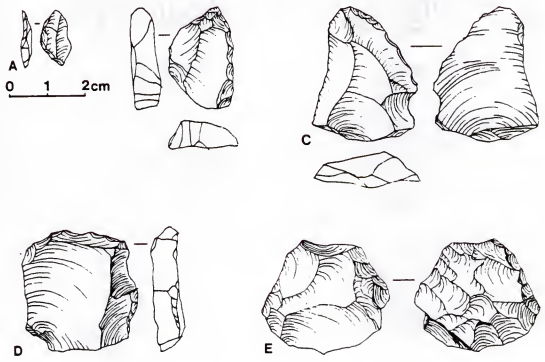


Figure 7-12: Survey Area 11 Stone Artifacts: A, crescent; B, straight-backed piece; C, unifacial point; D, sundry end and side scraper; E, disc core. Raw material: A-C, chert; D, quartzite; E, cloudy quartz.

scatter. Areas away from the shelters yielded low densities to isolated artifact scatters. Also the shelter floors yielded isolated scatters of artifacts. Holocene LSA and PN artifacts predominate in this survey area. However, MSA and late Pleistocene LSA artifacts are also represented by a few cores, flakes, and scrapers (Figure 7-12). The predominant raw material is quartz that occurs naturally in the survey area as exposed cobbles.

Isolated pottery fragments were also found. Although the pottery fragments are undiognistic, they seem to represent both "Kansyore" and "Narosura" Wares. Isolated scatters of recent bones in weathering stage 1 to 3 were found throughout the survey area. A small sample of about 100 stone artifacts were collected from the surface. About 55% of the collected artifacts were analyzed (Table 7-9).

Table 7-9: Survey Area 11 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	6	10.91
Scraper	10	18.00
Point	2	3.60
Subtotal	18	32.51
CORES		
Radial	5	9.10
Levallois	2	3.60
Single platform	1	1.80
Divers single platform	2	3.60
Subtotal	10	18.10
OTHERS		
Levallois flake	1	1.80
Utilized levallois flake	1	1.80
Flake	13	23.60
Utilized flake	3	5.50
Flake fragment	4	7.30
Utilized blade	1	1.80
Utilized angular fragment	2	3.60
Angular fragment	2	3.60
Subtotal	27	49.00
TOTAL	55	100.00

Three rock shelters contain rock art. These were named after the nearby village of Endanyawishi as Endanyawishi 1, 2, and 3.

Endanyawishi 1. This is an overhang on the southwest end of the survey area that border the Yaeda-Endanyawishi Graben. About 20 individual paintings were noted on an area of about 3.60 m^2. A panel with scenes of anthropomorphic

figures dancing or participating in a performance occurs. The paintings are in various shades of red. No other subject matters were observed at this rock shelter. However, this does not mean that other subject matters were not painted as about 80% of the paintings at this shelter are too faint to identify. In terms of style, subject matters, and color, the pictographs at Endanyawishi 1 fall under the art of the "Gatherers". There was no evidence of recent utilization of this rock shelter.

Endanyawishi 2. This is an overhang shelter resting on the same hosting block with Endanyawishi 3. This shelter is found near the northeast end of the survey area. Endanyawishi 2 is located northwest of Endanyawishi 3. Four individual paintings were observed on an area of about 0.50 m^2. The subject matters include two wild animals and an anthropomorphic figure. The fourth painting is bleached and therefore, undiagnostic. The painted subject matters are in motionless and naturalistic forms. The paintings are in red color. Neither archaeological material nor evidence of recent utilization of the shelter was found on the floor.

Endanyawishi 3. This is an overhang shelter occurring near the northeast end of the survey area. About 28 individual paintings were noted on area of about 11 m^2. On the basis of style, color, and subject matters, the paintings of Endanyawishi-3 can be divided into three painting phases. The first is the "Late-White Bantu" style that is represented by geometric: rectangles and parallel lines. The paintings

are in dirt white and black colors, and are located away from the other paintings.

The art of the "Hunters" is possibly represented at this shelter by a giraffe, an elephant, and anthropomorphic figures. Hunting scenes are, however, missing. On the basis of representation and association, the anthropomorphic figures can be subdivided into: 1) three human figures with crocodile-like heads, two hands, and three legs, 2) a tall human figure with unusually very tall arms, and 3) a group of human figures that are small and lack heads. The later group is drawn inside an enclosure. The subject matters are drawn in red color.

The other art represented is that of "Gatherers". This is represented by a baobab tree with hanging baobab fruits. Dancing anthropomorphic figures are, however, missing. The paintings are in various shades of red. Endanyawishi 3 had at least 28 paintings.

In terms of preservation, the paintings at Endanyawishi-1, 2, and 3 are in poor conditions. Weathering of the painting's paint, exfoliation of the rock bearing the paintings rock, the effects of rain water and other natural agencies have destroyed about 60% of the original paintings at these shelters. The present visible paintings are at risk of disappearing unless a protection program is implemented as soon as possible (Mabulla 1996).

Survey Area 12

Survey Area 12 is located in the Siponga-Masiedha Hills, east of the Yaeda-Endanyawishi Graben (Figure 7-10). Survey Area 12 is a hilly terrain characterized by many rocky outcrops and shelters. Dry stream channels or "gullies" characterize the terrain.

Survey Area 12 is located within the Acacia-Commiphora deciduous bushland and thicket type of vegetation. This survey area is also rich in plant resources including various species of tubers, roots, and fruits. Also acacia gum and dry bush fruits were present in the area. Resident animals such as antelopes, wild pigs, giraffes, and elands occurred to the west of the survey area in the Acacia-Commiphora deciduous wooded shrubland that fringes the Yaeda-Endanyawishi Graben. These can be spotted easily from top of the Siponga-Masidha Hills.

Survey Area 12 covers an area of 1.24 km^2. Systematic transect survey of this area was also hindered by the rocky terrain and spinuous thickets. Nevertheless, where terrain and vegetation allowed, transect surveys with crew members placed at 5 m intervals were conducted. Overall, about 60% of the area was surveyed. Because of the terrain's high gradient that can accelerate movement of surface artifacts, a considerable effort was given to survey the water "gullies" found in this survey area. We expected to find high density artifact scatters in the "gullies."

High density artifact scatters were found on the drip lines and slopes of rock shelters and rock outcrops. For example, a 1 m^2 unit located at the slope of !Qhadenaqwete 3 yielded 550 stone artifacts from the surface. Other areas away from the rock shelters yielded low density to isolated artifact scatters. The artifacts found in the water "gullies" ranged from virtually nothing to isolated scatters. Artifacts of "Njarasan" and MSA cultural stages are represented by isolated scatters of various types of cores, scrapers, heavy-duty tools, and levallois flakes. Few of the MSA artifacts were found on the slopes of rock shelters (Figure 7-13). In terms of surface density, LSA and PN artifacts predominate, especially around rock shelters. Neither pottery nor fossilized bones were found on the surface away from the rock shelters. However, isolated recent bones ranging from weathering of stage 1, to 3 were found. High density scatters of fresh bones of a cow were found on the drip line and slope of Qhadenaqwete 3 (see below).

Ten rock shelters were found to have rock paintings and dirt floors. These were named as Qhadenaqwete 1 to 10, a Hadzabe name for this area. Because of time constraints, only the paintings of three shelters (Qhadenaqwete 1 to 3) will, however, be described here. The three shelters are found near the eastern end of the survey area. They form a "chain" of painted shelters that are separated from each

other by few meters. Qhadenaqwete 1 and 3 rest on the same hosting block.

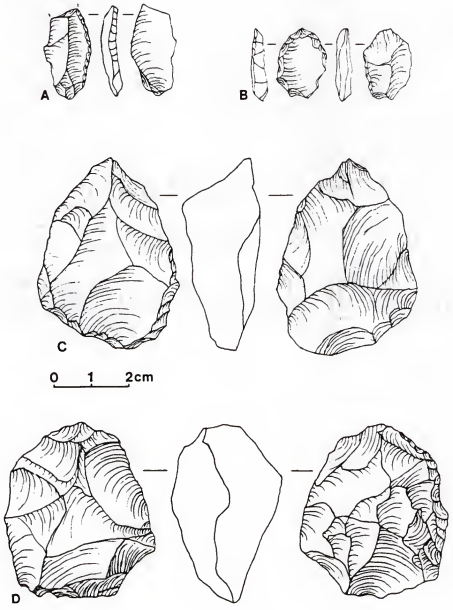


Figure 7-13: Survey Area 12 Stone Artifacts: A, curve-backed piece; B, circular scraper; C, biface; D, radial core. Raw Material: A and B, clear quartz; C, cloudy quartz; D, chert.

Table 7-10: Survey Area 12 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	9	12.86
Scraper	3	4.29
Point	6	8.58
Burin	3	4.29
Subtotal	21	30.02
HEAVY-DUTY TOOLS		
Core scraper	1	1.43
Biface/pick	5	7.14
Subtotal	6	8.57
CORES		
Radial	1	1.43
part-peripheral	1	1.43
Pyramidal	1	1.43
Single platform	2	2.86
Multiple	5	7.14
Opposed double platform	6	8.57
Bipolar	2	2.86
Amorphous	1	1.43
Subtotal	19	27.15
OTHERS		
Levallois flake	3	4.29
Flake	12	17.14
Utilized flake	3	4.29
Flake fragment	1	1.43
Denticulate fragment	1	1.43
Angular fragment	4	5.71
Subtotal	24	34.29
TOTAL	70	100.00

Ohadenaqwete 1. About 60 to 70 individual paintings were noted on an area of about 15.80 m^2. On the basis of subject matters, color, superimposition, and style, four painting phases are discernible. The "Bantu" phase is the latest painting at this shelter. At this shelter, the "Bantu" is characterized by schematic and geometric subject matters. These include series of parallel lines, tallies, astral, and solar shapes. Human figures are depicted in pairs. Depiction of weapons and domesticated and wild animals are, however, missing. The predominant color is dirt white. One figure is however painted in reddish brown color.

The art of the "Hunters" is characterized by the dynamic movement given to the figures depicted and by the care and great attention given to details (Anati 1986). At this rock shelter, this phase is represented by panels of hunting scenes. For example, two human figures are depicted with bows and pointed respectively towards a giraffe and an eland. The human figures, however, lack the head dresses. The giraffe is much larger in dimension than the other figures. The other depicted animals include a hyena, buffalo, and an ostrich. The ostrich is painted in simple outline while all the other animal paintings are filled in. All the animal figures are depicted in their naturalistic forms with much care and great attention given to details. The figures are painted in various shades of red. Some of these red painted figures are superimposed on yellow painted human and animal (eland?) figures. The human figure is very large and it has a head dress. Painting of the animal was not completed as it lacks a head. All the paintings are filled in and are painted in yellow.

Holocene LSA and PN artifacts were found on the floor of !Qhadenaqwete 1. These were in direct association with MSA and Pleistocene LSA artifacts at the slope of the shelter. Although no item of Hadzabe material culture was found on the floor of the shelter, recent ashes, charcoal fragments, and food debris (bones, turtle shells, etc.,) suggest recent utilization of the shelter by Hadzabe foragers.

Qhadenaqwete 2. About 36 individual paintings occur on an area of 10 m^2. Two types of painting are discernible at this shelter. The art of the "Bantu" is represented by schematic and geometric depiction of a series of parallel lines, rectangles, and crosses. All the paintings are in white to "dirt white" color. Sometimes the paint was poured on the rock surface and fingers were then used to draw the lines (hand stencils).

The art of the "Hunters" is represented by hunting scenes. Hunters are depicted with hunting weapons such as bow and arrows, and wooden clubs. Other human figures are without hunting weapons and shown standing up together as a group. Another group has human figures drawn in horizontal anatomical positions (possibly portraying people lying down or at rest?). A herd of animals is depicted with the animals lined up together. The animals depicted include giraffes, zebras, birds, wild dogs, antelopes, baboons, and elands. Again the giraffe is much larger than the other animal figures. All the paintings are drawn in various sheds of red.

Qhadenaqwete 2 has evidence of recent occupation by Hadzabe foragers as a fragment of Hadzabe tobacco pipe, food debris, and circumscribed sleeping places were found (see Chapter 5). Holocene LSA and PN artifacts were also found on the shelter's floor.

Qhadonaqwete 3. About 50 individual paintings occur in an area of about 12 m^2. At least two phases of painting are

identifiable at this shelter. The art of the "Hunters" is represented by a hunting scene. A human figure is drawn holding a bow and an arrow pointed to an elephant. The paintings are in red color.

The art of the "Gatherers" is represented by a turtle and a reptile-like creature painted in weak red. Also represented are various scenes of anthropomorphic beings depicted dancing or participating in performances (ritual activities?). These anthropomorphic figures lack facial details (supernatural beings or imaginary creatures?). Other subject matters include wavy-like patterns or symbols, cylindrical forms, fish-like creatures, and trees (baobab?) with many branches. The painted animals include baboons, giraffes, a hartebeest, an elephant, a hyena, lizards, a buffalo, and zebras. One human figure without weapons is painted running in front of a charging buffalo.

Qhadenaqwete 3 provide clear evidence of utilization by the Hadzabe foragers (see also Chapter 5). Isolated artifact scatters of Holocene LSA and PN affinities were found on the shelter's floor. However, a high density artifact scatter was found on the shelter's slope. This high density scatter has both MSA, Pleistocene LSA, Holocene LSA and PN artifacts.

In terms of preservation, the paintings of Qhadenaqwete-1 and 2 were in a fair state. However, those of Qhadenaqwete 3 were in a poor state. Both human, animal, and natural agencies are the major factors contributing to the erasure of these paintings (Mabulla 1996).

Survey Area 13

Located in the Siponga-Masiedha Hills (Figure 7-10), this survey area also is found within the *Acacia-Commiphora* deciduous bushland and thicket type of vegetation. The area is rich in flora resources that are exploited by the Hadzabe foragers. The hill slopes, for example, are rich in tuber and root plant foods. Also found in this area are baobab trees. The lower slope areas that fringe the Yaeda-Endanyawishi Graben are rich in *Cordia sinensis* and *Salvadora persica*. Small groups of resident animals were found in the lower slopes that fringe the Yaeda-Endanyawishi Graben. Isolated animals such as elands were found upslope. This area was selected for survey because of its geomorphic- and eco-zones and its potential for finding shelters documenting prehistoric and historic utilization of this landscape by foragers.

This survey area covers about 1.50 km^2. Likewise the terrain and vegetation cover of this survey area also impeded our systematic transect survey. Overall, only 50% of the area was surveyed yielding low density to isolated artifact scatters. Unlike in some of the survey areas where density artifact scatters were found eroding on rock shelter's slopes, the lithic artifacts were approximately evenly distributed in this survey area. The recovered materials include artifacts of the "Njarasan", MSA, and LSA cultural stages (Figure 7-14; Table 7-11). Quartz is the predominant

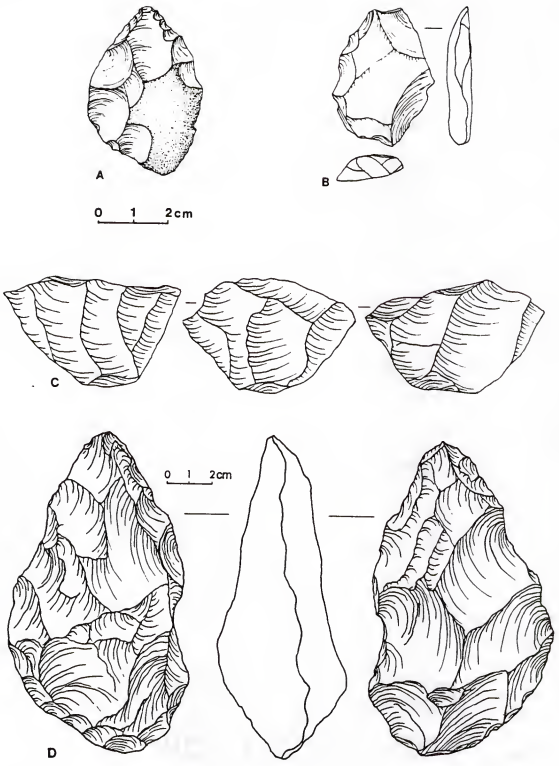


Figure 7-14: Survey Area 13 Stone Artifacts: A, unifacial point; B, convex side scraper; C, radial core; D, diminutive hand axe. Raw Material: A, C, and D, cloudy quartz; B, chert.

raw material and occur naturally as exposed boulders and cobbles. Pottery remains and fossilized bones were not recovered from the surface. The only bones found on the surface were all recent and in various stages of weathering.

Table 7-11: Survey Area 13 Surface Artifacts.

SHAPED TOOLS	N	% TOTAL
Backed piece	1	2.50
Scraper	6	15.00
Point	2	5.00
Burin	1	2.50
Bec	2	5.00
Subtotal	12	30.00
COMPOSITE TOOLS		
Backed and other	1	2.50
Scraper and other	1	2.50
Subtotal	2	5.00
HEAVY-DUTY TOOLS		
Core scraper	1	2.50
Dimunitive handaxe	1	2.50
Core-axe	1	2.50
Backed core	1	2.50
Subtotal	4	10.00
CORES		
Part-peripheral	1	2.50
Disc	4	10.00
Divers single platform	2	5.00
Bipolar	4	10.00
Subtotal	11	27.50
OTHERS		
Levallois flake	2	5.00
Flake	6	15.00
Utilized flake	1	2.50
Blade	1	2.50
Angular fragment	1	2.50
Subtotal	11	27.50
TOTAL	40	100.00

Moreover, we observed four Hadzabe abandoned camps fringing Survey Area 13 to the west. Only one camp had visible hut structures and it was occupied a year ago before our survey. At the other three camps that were occupied between two and five years ago, the only visible evidence of

Hadzabe occupations was isolated scatters of Hadzabe items of material culture (tobacco pipe fragments, beads, hearths, etc.,), food debris (e.g., bones and baobab fruit seeds), and pounding or grinding stones (lower stone is an *in situ* rock). Our identification of the three camps as Hadzabe camps were confirmed by our Hadzabe informants (Madulu Mahiya, personal communication 1993).

Four rock shelters were found to have rock art. These were named as Siponga 1 to Siponga 4. Because of space constraint, only the paintings of Siponga 3 and 4 will be described here.

Siponga 3. This shelter is an overhang, facing west. About 24 individual paintings were noted in an area of about 17.60 m^2. The art of the "Hunters" is represented by animals and human figures with bow and arrows. The animals depicted include an elephant, a giraffe, antelopes, zebras, and reptile-like creatures. Some of the animals are large, up to 0.93 m in length (e.g., the elephant). Also represented are insects. However, the animal and human figures are not in association.

The bodies of the human figures are drawn either in outline or filled-in forms. Their heads are round and filled-in. Careful attention is painted to decorations around the waist and knee positions. The animals are represented in their naturalistic occurrences (e.g., the giraffe's body is filled-in by dots). The paintings are in reddish-brown color. The art of the "Gatherers" is represented here by

scenes of anthropomorphic figures depicted as dancing, participating in a performance, or ritual activities (trance?). Another subject matter represented is "skirts". The paintings are in red color.

Another art that could not be placed into Anati's (1986) socio-economic approach to rock art is that of three paintings of lioness. Two of the lioness are associated. The paintings are in "dirt" yellow color. This art is possibly the earliest at this shelter as it is stratified below the other arts.

The floor of Siponga 3 is an exposed bed rock and lacks any sediment deposits. Neither archaeological material nor evidence of recent utilization of this shelter was observed. In terms of preservation, the paintings of this shelter are in a fair condition.

Siponga 4. This is a straight-faced shelter. More than 16 individual paintings were noted on area of about 4.05 m^2. Possibly the art of the "Hunters" is present at this shelter. Nevertheless, paintings of hunting scenes or human figures with bow and arrows are missing. The subject matters include an elephant, a giraffe, zebras, antelopes, and human figures. Some of the human figures are painted inside an enclosure or "boma". The paintings are in various shades of red. The preservation condition is poor.

The floor of this shelter is also an exposed bed rock without sediment deposits. No archaeological materials were

found on the surface of the floor. Also, the shelter lacks any evidence of its recent utilization.

Survey Area 14

This survey area is also located in the Siponga-Masiedha Hills (Figure 7-10). The terrain, vegetation type, fauna, and flora of this survey area are similar to that described previously for Survey Area 12. The area was selected for survey because of its potential for finding shelters with rock paintings. Similarly, systematic transect survey of this area was implemented only where the terrain and vegetation allowed. About 50% of the area was surveyed.

Survey Area 14 covers an area of 0.56 km^2. Generally, this survey area yielded isolated artifact scatters. The only low density artifact scatters were found on the slopes of a compound rock shelter with three shelter floors, named Endahakichandi 2a, 2b and 2c. The artifacts on these shelter slopes are primarily of LSA affinity. The artifacts were in direct association with isolated ostrich eggshell beads, sub-fossilized bone fragments, and potsherds of the Narosura Ware. Although quartz occurs naturally throughout the survey area as cobbles, many of the lithic artifacts at Endahakichandi 2a, 2b, and 2c were made from river pebbles (see Chapters 8 and 9). The source for this raw material is the nearby Udahya River.

Throughout the survey area, isolated artifact scatters of the "Njarasan", MSA, and late Pleistocene LSA affinities were found (Figure 7-15). Holocene LSA and PN materials were

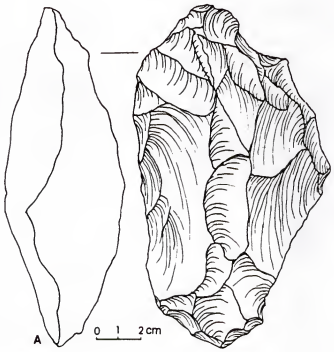


Figure 7-15: Survey Area 14 Stone Artifacts: A, heavy-duty core-axe. Raw Material: cloudy quartz.

found around rock shelters. Neither pottery nor fossilized bones were found in other parts of the surveyed area, beside Endahakichandi 2a, 2b, and 2c. Recent bones in weathering stage 1 to 3 were found as isolated findings, scattered throughout the survey area.

Four rock shelters were found to have rock art. These rock shelters were named after the nearby village of

Endahakichandi. Because of space limit, only the rock art of two shelters will be described here.

Endahakichandi 1. This shelter has paintings of the "Gatherers". These are represented by anthropomorphic figures, some of which are in dancing positions. One of the human figure has an animal-like body from the waist to the legs. No archaeological material was found at the shelter's floor. Possibly this is due to the exposed rocky floor as it lacks the sediments that would trap and deposit the artifacts. Also, the shelter lack any evidence indicating recent utilization by the Hadzabe foragers.

Endahakichandi 2a and 2b. The art of the "Bantu" is represented at Endahakichandi 2a by nine geometric and schematic paintings. These include rectangles, circles, astral, dots, and parallel lines in "dirt white." Some of the paintings are simple hand stencils. One of the "Bantu" painting is superimposed on top of "Gatherers" paintings. The art of the "Gatherers" is represented at this shelter by five anthropomorphic figures that are depicted dancing.

On the floor of Endahakichandi 2a we found a fragment of Hadzabe tobacco pipe, recent pottery fragments, and food debris indicating it's recent utilization by Hadzabe foragers. Long bone fragments of a small-sized animal were found in direct association with a battered hammerstone. The patterns of the bone breakage and battering of the hammerstone indicate that the hammerstone was used to break-up the bones.

At Endahakichandi 2b, the art of the "Hunters" is represented by hunting scenes. Human figures, some of which are small in size (children?) are shown with bows and arrows pointed to animals such as giraffes and antelopes. Also a wild dog is depicted. Some of the animals are depicted feeding on grasses and leaves. All the paintings are in red color.

Large groups of anthropomorphic figures depicted dancing represent the art of the "Gatherers" at this shelter. The bodies of these human figures are filled-in by parallel lines. One group of anthropomorphic figures is painted dancing in front of a giraffe. Facial details are missing. Some of the human figures are ghost-like (in trance?).

Endahakichandi 2b has recently been vandalized by treasure hunters. Part of the shelter's floor was excavated and some of the paintings were defaced. The paintings at this shelter like all the others in the Eyasi Basin are endangered (Mabulla 1996).

Survey of Environmental Processes

The view that the distributions of artifacts will reflect both cultural and environmental processes (c- and -n transforms) has been expounded at length by Schiffer (1995) and others. Despite this, many archaeological surface surveyors in East Africa, rarely consider the processes that have influenced the patterning of surface artifact scatters. To exclude such processes limits the potential of surface-

derived data for answering research questions. As such, recognition of the processes that created the context of artifact recovery was a necessary methodological step for this research.

The major cultural processes that influence the context of artifact recovery (e.g., rock art and archaeological deposits in rock shelters) in the Eyasi Basin have been presented in Mabulla (1996). In the following sections, I present the results of survey for the environmental processes.

Stratigraphy of Lake Eyasi

Due to the uncertainty of the stratigraphy and age of the Eyasi hominid crania and the "Njarasan" Industry, we sampled exposed salt-flat sediments of the Eyasi Beds to search for dateable material and further investigate the stratigraphy. Moreover, during survey, we also looked for "proxy" data such as ancient lake level stands that may indicate past environments in the Eyasi Basin.

The area that was selected for stratigraphic study is located in the northeast section of Lake Eyasi, about 14 km from the Skull Site (Figure 7-1). We dug two stratigraphic units, G1 and G4 (Figure 7-16). Stratigraphic unit G1 was located about 1 km from the modern lakeshore and G4 was located about 0.6 km east-south east of G1. In addition, we observed exposed stratigraphic sections of the Eyasi Beds at G2 and G3.

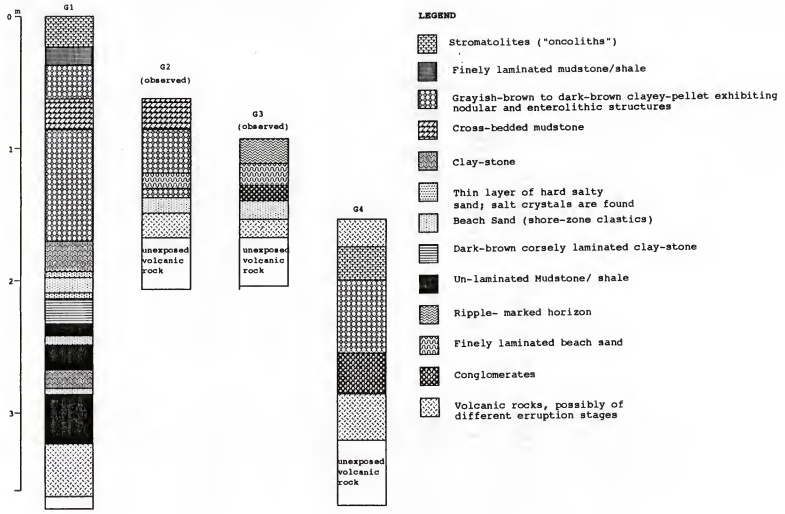


Figure 7-16: Four Geological Trenches Showing the Stratigraphy of Lake Eyasi.

The four stratigraphic units show the sedimentation history of Lake Eyasi (Figure 7-16), revealing that the Eyasi Beds were deposited between two or more volcanic eruptions, following a period of regional faulting. The sources of the volcanic material are possibly the Oldeani, Sadiman, and Ngorongoro Mountains that flank the Eyasi Basin in the north. The exposed (G1 and G2) and observed (G2 and G3) volcanic rocks are mud flows in nature, suggesting that volcanism was probably brought close to Lake Eyasi by the formation of scoriaceous lava cones along the ancient lakeshore. One small vent composed of scoriaceous lava was found near the ancient beach line surrounded by metamorphic rocks, probably representing the closing phase of volcanism in the region. This vent has been dissected, but it shows a typical outline of a volcano.

The stratigraphic sequence of the Eyasi Beds in the northeastern lakeshore complements that at the Skull Site as described by Mehlman (1987, 1989). Nonetheless, our stratigraphic sequence is much longer, with volcanic rocks of two or more different histories and clusters of *in situ* stromatolites.

Regional volcanism, together with repeated faulting episodes appear to have deposited enormous amounts of volcanic mud and sediments in the lake. At present, many of the streams and the two large rivers (Mbarai and Sibiti Rivers) drain their waters and sediments into Lake Eyasi. Considering the present nature and shape of Lake Eyasi, it

should have had a very large holding capacity to support such large amount of sediments. This large holding capacity has to be in form of depth. Although, the actual thickness of the Eyasi Beds has not yet been established, the stratigraphy of the Eyasi Beds suggest that Lake Eyasi was a deep lake in the past.

Age of the Eyasi Beds

Although, we could not recover (due to lack of boring equipment) *in situ* fresh samples of volcanic rock for chronometric dating, the presence of volcanic lava within the Eyasi Beds supports Mehlman's interpretation that the Eyasi Beds were deposited during Middle Pleistocene. Recent studies indicate that the latest regional faulting and volcanism took place around 800,000 to 400,000 BP (Manega 1993; Somi 1993). If the magnitude of this latest regional volcanism reached the Eyasi Basin, then it can be suggested that the volcanic material within the Eyasi Beds date to at least 400,000 BP.

Past Environments

Equally important, climatic factors played major roles during the deposition of the Eyasi Beds. In closed lakes like Lake Eyasi, climate can influence the mean water level, chemical composition, temperature, and organic productivity of the lake (D. Hodell personal communication 1992; M. Mutakyahwa personal communication 1994).

Desiccation of Lake Eyasi during the Eyasi Beds is indicated by evaporates with well-developed salt crystals and the reddish pelletoid clay or evaporate replaced clays (A. Kweka personal communication 1993; M. Mutakyhwa personal communication 1994). Thin layers of hard salty sands occur in section G1 (Figure 7-19). They indicate that the sediments were seasonally exposed to hyper-saline processes (e.g., dry environments) whereby salt crystals were concentrated at the surface by evapotranspiration (see Hay 1976).

Clayey-pellet structures are formed by either diagenesis of salty clayey sediments (replacements of the evaporate anhydrite) (M. Mutakyahwa personal communication 1994) or by wind erosion of exposed mud-flats (Hay 1976). The clayey-pellets suggest brief retreats of the lake water levels during a period of increased aridity. The cross-bedded mud-stones in sections G1 and G2; and oscillation ripple marks in section G3 shows the works of turbulent flow of water and waves along a shore (see Hay 1976; Figure 7-19). Similarly, the sand levels in sections G1, G2, G3 and G4; and the rubble or conglomerate levels in sections G3 and G4 indicate beaches or lake margin environments (Figure 7-19).

Humid conditions during the Eyasi Beds are shown by the clay-stones and mud-stones of sections G1 and G2. These features indicate that were deposited in deep bodies of water where the activities of waves and currents were minimal (see Hay 1976). The *in situ* occurrences of clusters of

stromatolites in section G1 and G4 are also indicative of biological processes in water environments (Figure 7-19).

Evidence for arid and humid conditions in the Eyasi Basin is not only restricted to sedimentological and other "proxy" data found in the Eyasi Beds. Our survey of metamorphic rocks along the lake shore and the escarpments that fringes Lake Eyasi scarps provide evidence of ancient high lake level stands.

Caved rock blocks and slabs due to wave actions were observed along the lake shore inselbergs at different heights, up to 100 m above modern lake shore. *In situ* occurrences of stromatolites on rock block or slab surfaces, also at different heights (up to 100 m) above modern lake shore were observed throughout the lake shore inselbergs.

More stromatolites were found on the slopes of metamorphic rocks and hills fringing Lake Eyasi to the east. Isolated algar and stromatolites were also observed *in situ* on cavern surfaces of rocks in the Eyasi Rift Scarp, about 200 m above modern lake shore. The growth of algar and stromatolites on the Eyasi Rift Scarps were probably limited or reduced by strong wave or wind actions. The widespread occurrences of stromatolites and other high lake level stand indicators clearly supports the idea that under the wet season of the humid climate, the landmass surrounding Lake Eyasi would have been submerged (see Chapter 2).

Our preliminary stratigraphic, past environments, and chronological study shows that the Eyasi Basin hold a key to

unravel the interplay between tectonism, volcanism, sedimentation, fauna (including hominid), biota, and culture in a rift environment. More collaborative (with specialists) works that will core the lake for past environmental and geomorphological studies, chronometric dating, and identifying the stages of high lake level stands are, however, needed for a proper understanding not only the environmental processes that influenced the distribution of artifacts, but also the interactions between hominid, culture, and environments.

Surface Formation Processes

The major pattern recognition problem posed by surface artifact scatters is the recognition of post-depositional patterning and to what extent it limits the potential of surface-derived data for answering research questions.

The major post-depositional process observed or recorded in the Eyasi Basin which has had an impact on artifact distributions is natural processes. On a general level, this can be divided into: 1) erosional, 2) gravitational, and 3) depositional processes.

Erosional processes. Erosion, whether modern or prehistoric, is obviously a factor that must be considered when analyzing surface artifact distributions. There is no doubt that severe rilling and gullying can, and does, remove artifacts from the area of human deposition. Concentrated channeling processes will indiscriminately remove a small

percentage of the soil, including artifacts. However, as only a thin layer of soil and artifacts are removed, this will only result in the general reduction of artifact densities within the gullied or rilled areas.

Gravitational processes. Down slope movement of artifacts by purely gravitational processes does not seem to be a significant factor on the surface artifact scatters. This is because gravitational processes work better on steep slopes that lack vegetation cover. However, in the Eyasi Basin, there are no steep slopes that completely lack vegetation cover.

Depositional processes. Deposition will result in extreme sorting and redistribution of artifacts. Artifacts are likely to be deposited at the base of slopes and valley bottoms. These zones are the most likely to accumulate finer material. Burial of artifact scatters and redeposited artifacts may, therefore, occur comparatively rapid. If this is the case, no severe distortion will be noticed from observation of surface artifact scatters upslope, but the lower slopes and valley bottoms may be totally obscured. To remedy this bias, few lower slope and valley bottom areas were selected for survey.

Summary

In this chapter, I have presented the results of the surface field survey by describing the locations of surveyed areas and cultural affinities of their archaeological and

ethnographic findings. Moreover, I have described the ecological and distributions of natural resources within each surveyed area and the environmental processes in the Eyasi Basin. I believe that the data presented in this chapter and the use of land-use models (see Chapter 2 and 5) may provide a valuable insight into the dynamic behavior behind the distributions of surface artifact scatters in the Eyasi Basin. What does the occurrences of both "Njarasan", MSA, Pleistocene LSA, Holocene LSA, and PN artifactual materials in the same surveyed areas tell us about MSA and LSA forager land-use systems? This question will be explored in Chapter 10.

CHAPTER 8
FIELDWORK: TEST EXCAVATION

Introduction

The primary objective of the test excavations was to assess the potential of the Eyasi Basin for future long-term research. I expected to recover subsistence, hominid remains, dateable material, and other artifactual material to complement the surface evidence. East African archaeology has been slow in integrating surface and excavation data in interpreting the past. Nonetheless, it is only by combining the two forms of evidences that a clearer and more meaningful picture of the past can emerge. As a step toward this goal, I present in this chapter, the results of the test excavations and consider the recovered artifactual materials.

Results of Test Excavations

Test excavations were undertaken in four surveyed areas: Survey Areas 1, 11, 12, and 14. Although natural stratigraphy was discernible at some shelters, excavations proceeded by arbitrary levels unless a feature was clearly identified (see Chapter 6). The artifacts from each spit of each pit were analyzed separate, however, on the basis of stratigraphy and typology, the artifacts from the each

shelter are hereby combined into more manageable but still meaningful groupings. The faunal remains have yet to be analyzed by specialists, but the sample sizes are very small and probably cannot provide meaningful inferences about subsistence behavior.

Survey Area 1

Test excavation of this survey area was undertaken at Gordfani 1 and 2 rock shelters. These two rock shelters occur on two big boulders. Both shelters face the south. Gordfani 1 has a floor area of 13 m^2 and Gordfani 2 is 24 m^2. Gordfani 1 has blurry rock paintings.

Gordfani 1

Two 2 m^2 (1 m x 2 m) test units were established using a transit and a Brunton compass. Test Pit 1 (TP1) (N8.6W1) was placed on the shelter's slope and TP2 (N10.6W0) on the floor of the shelter (Figure 8-1). TP1 was excavated to a depth of 90 cm below surface (BS) or 125 cm below unit datum point (BUDP). Excavation of this unit was possible only in small pockets between the underlying rocks. It was impossible to proceed deeper below level IX.

TP2 was excavated to a depth of 80 cm BS or 110 cm BUDP. Excavation of this pit also was made difficult by the numerous underlying rocks. A large *in situ* rock was exposed during the excavation of level II. At the floor of level II,

this underlying rock covered 75% of TP2 and in level V it covered about 90% of TP2 .

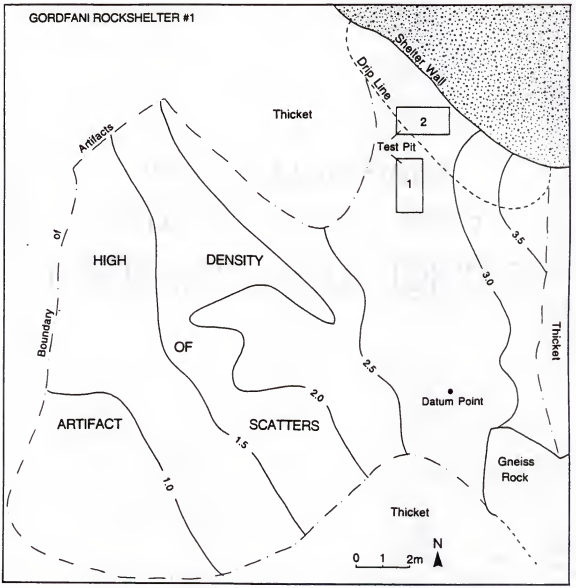


Figure 8-1: Contour Map of Gordfani 1.

Litho-stratigraphy

For most of the sequence, the sediments were fine grained and unconsolidated aeolian sandy soil (Figure 8-2). Starting at the surface, there was a layer of fine dark grayish brown (2.5Y 3/2) sediments, Layer I. This layer continued to about ± 45 cm BS.

Layer II consisted of a dark brown consolidated (7.5YR 3/2) aeolian sediment mixed with gneiss gravels and cobbles. This layer was about 20 cm thick. The final layer, III, which went from about ± 70 cm to 90 cm BS, had a somewhat consolidated coarse grained and very dark grayish brown (10YR 3/2) sandy sediment mixed with ash. Also characteristic of this layer is the large numbers of weathered gneiss fragments.

Radiocarbon Dating

Two charcoal samples from Levels VI and VIII were submitted to the Geochron Laboratories for dating. Radiocarbon dates of 245 ± 115 BP and 85 ± 300 BP (C-13 corrected) were recorded for the Level VI and VIII samples respectively. In terms of the recovered artifacts, the dates are too young, suggesting that the dated charcoal samples were either of recent origin or contaminated. Furthermore, the dates are stratigraphically inverted indicating that the charcoal samples were of recent origin and were probably introduced into the lower deposits by either recent human

activities at the shelter or other disturbance processes (e.g., burying animals). The two ^{14}C dates are, therefore, unacceptable.

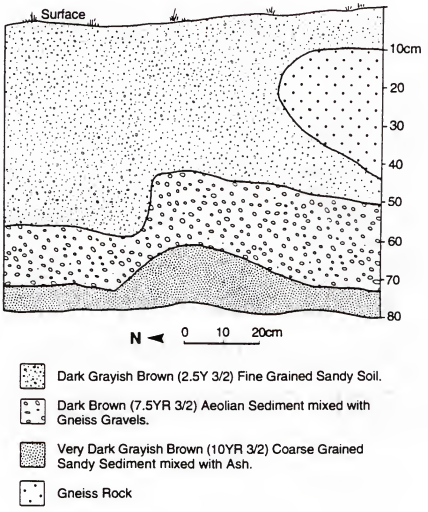


Figure 8-2: Litho-stratigraphy of Gordfani 1.

Material Remains

Artifact and ecofact content were highest in the upper dark grayish brown Layer I, medium in Layer II, and lesser in the very dark grayish brown Layer III.

Stone artifacts. The two test pits yielded a total of 1,226 stone artifacts. About 68% of the stone artifacts were recovered from the upper 40 cm. There was a dramatic decrease in the number of artifacts recovered as one proceeded down the pits. This may be a reflection of a decrease in the volume of excavated deposits, rather than a decrease in the intensity of occupations.

The Gordfani 1's lithic assemblage is dominated by angular fragments, followed by flakes, unmodified pebbles and cobbles, cores, and lastly tools. Some of the angular fragments have evidence of utilization. Four of the unmodified pebbles and cobbles have one or two flake scars but lack sufficiently well-defined platforms to classify them as cores. The behavioral implications of this are not clear but it may indicate testing of raw material quality. Eleven kinds of cores are recognized. By far, the most common is the single platform core (Table 8-1). A part-peripheral core from Level 7 (60-70 cm BS) of PT2 is on a previously detached large plain platform flake. This core has two types of patination. The first is heavy and possibly associated with the initial manufacture of the flake. The second patination is light. Undoubtedly this previously detached flake served

as raw material for later knappers, indicating re-use of raw materials.

Twenty-five shaped tools were recovered, mostly from the upper 40 cm BS (Table 8-1). Six basic classes of shaped tools are evident. These are scrapers, backed pieces, scaled pieces (e.g., *outil écaillé*), becs, and denticulates (Figure 8-3). By far, scrapers dominate (Table 8-1). Heavy-duty tools are represented by core choppers and core scrapers.

The occurrences of standardized core forms (e.g., disc, radial, pyramidal, levallois, etc.,), and bifacially modified implements indicate a systematic lithic reduction strategy that utilized the core's peripheral edge as the striking platform. Nonetheless, a casual technology was employed as shown by the presence of a minimally retouched cobble and amorphous cores. The high proportions of angular fragments, unmodified lithic raw materials, and cores indicate that tool manufacturing was carried out at the shelter. This is further supported by the occurrences of core fragments and hammerstones. Most of the hammerstones are sub-hemispherical in form with heavily bruised edges; they range from 0.45 to 0.915 kg in weight. The low number of recovered shaped tools suggest that some of the tools were transported and discarded to areas of cultural activities away from the shelter. As evidenced by utilized flakes, utilized angular fragments, broken tools, and ecofacts, the shelter was not only a tool manufacturing location, but also a habitation place. A range

of tools was manufactured and maintained, used, and discarded at the shelter.

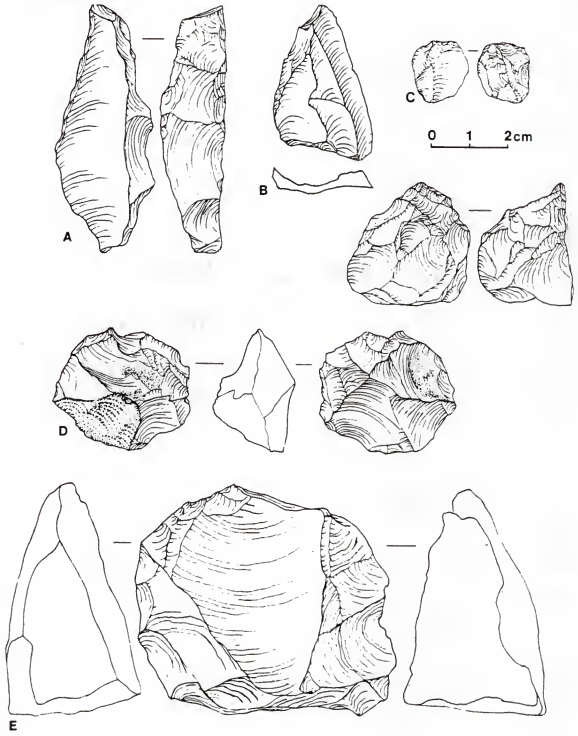


Figure 8-3: Gordfani 1 Artifacts: A, straight-backed piece; B, flake; C, discoid; D, radial core; E, heavy-duty scraper; F, unifacial point.

Table 8-1: Gordfani 1 Stone Artifacts.

	Levels									
	I	II	III	IV	V	VI	VII	VIII	IX	Total
SHAPED TOOLS										
Backed	1	1	1	1	1					5
Backed fragment			1			1				3
Scrapers	2	1	1	1					1	6
Scraper fragment	1		1		1		1			4
Outil écaillé	1	1	1							3
Bec								1	1	2
Burin									1	1
Denticulate			1							1
Subtotal										25
BIFACIALLY MODIFIED PIECES										
Bifacially modified							1			1
Point rough-out							1			1
Subtotal										2
HEAVY-DUTY										
Core scraper	1	2	3		1					7
Core chopper				1			1			2
Retouched cobble				1						1
Subtotal										10
CORES										
Bipolar	3	6	4					1		14
Single platform	8	10	11	5	2	1	1	1	2	41
Radial	3	1		3			1	1		9
Part-peripheral	1	2	2	1		1	1	1		9
Multiple platform	1	1		1			1			4
Pyramidal	2				2					4
Opposed double platform	2	6	9	2	1	1		1	2	24
Levallois			1							1
Disc			1							1
Adjacent double platform			1							1
Amorphous				1						1
Subtotal										109
UTILIZED										
Flake	3	4	4	2	1	1	3	2	1	21
Flake fragment	1		1	2	1	1	3	2	1	12
Angular fragment	4	3	3	2	1		1			14
Levallois flake			1							1
Blade segment					1					1
Subtotal										49
OTHERS										
Hammerstone		2	3	1				1		7
Core fragment	3	1		2	3	1			3	13
Pestle rubber			3							3
Levallois flake		1	4							5
Blade		2	3							5
Burin spall							1	1		2
Subtotal										35
TOTAL	37	51	53	27	15	7	11	15	14	230

Ceramics. The two test pits at Gordfani 1 yielded a total of six potsherds. Four of the six were recovered in the upper four levels (0-40 cm BS). The rest were recovered from level 8 (70-80 cm BS) of TP2. All the pottery fragments are plain body sherds belonging to different vessels. One of the sherds has a thick wall of about 10.2 mm. Some of the sherds are burnished while others are not. The tempering materials are quartz and mica. Given that mica is locally available, I suggest that the ceramics were manufactured locally. In the future, this assumption will be tested by a petrographic study. Given the small sample size of the Gordfani 1's ceramic assemblage and their undiagnostic nature, it is difficult to place them into the Eyasi Basin ceramic sequence as defined by Mehlman (1989). Since IA material are absent and polished stones of the PN period are restricted to the upper 40 cm, it is reasonable to assume that the potsherds from the upper 40 cm may represent the PN "Narosura" Ware while those in the lower levels may belong to the Holocene LSA "Kansyore" Ware.

Shell artifacts. Ostrich eggshells and bivalve shells were favorite materials for making ornaments, especially beads. The beads are small, flat, and circular in form. The beads are in various stages of manufacture, ranging from blanks, drilled blanks, to finished beads. A drilled semicircular but unfinished bead fragment of ostrich eggshell indicates that some of the manufactured beads were broken during the manufacturing process. Accordingly, it can be

inferred that bead manufacturing took place inside the shelter. Beads were found in all levels of Gordfani 1 deposits.

Ecofacts. Animal bones were recovered throughout the deposit. With the exception of Level 1 that produced non-fossilized bones, the other levels produced sub-fossilized to fossilized bones. Some of the bones were burnt. On the basis of the recovered bones, both medium and large-sized game were utilized at Gordfani 1. The exception is Level 1 that yielded only the bones of small animals. Since most Level 1 bones are un-fossilized, it is possible that they resulted from recent cultural activities at the shelter.

Mollusk and ostrich eggshell fragments were recovered throughout the deposit, although the latter was sparse. *Achatina* (sp.) was present in most levels, ranging from complete juveniles to complete adults to fragments. It is possible that the *Achatina* shells were introduced by live animals burrowing into the deposits to aestivate. Since only ostrich eggshell fragments were found, it is not clear at present whether ostrich eggs were brought in first as food or as containers and the shells subsequently made into ornaments, or if shells were collected from broken eggs for bead manufacture.

Summary History of Gordfani 1

Gordfani 1 provides insights into the activities carried out at habitation areas. In summary, it was occupied by

either both Holocene foragers and PN people or Holocene foragers who interacted with PN people. The occurrences of polished stones (e.g., pestle rubbers) together with chipped stones in the four top levels (0-40 cm BS) indicate either a PN period or forager/PN interactions. In the lower levels, polished stones are lacking. However, since ceramics are also found in the lower levels, the lithic assemblage may belong to the Holocene LSA. Although true bedrock was apparently not reached, it is unlikely that there is much deposit below the underlying rocks.

Lithic raw material uses do not change through time as cloudy quartz remains the dominant material throughout the shelter's sequence. This may indicate a pattern of localized lithic raw material procurement and use. Also, there is no clear shift in the technology and types of tools produced throughout the sequence.

Gordfani 2

Two 1 m^2 test pits were excavated in this shelter. Both test pits were placed on the floor of the shelter (Figure 8-4). Excavation of TP1 (N6W0) was stopped at Level IX, 90 cm BS or 144 cm BUDP when we reached bedrock. *In situ* rocks were exposed in Level III in the northwest and northeast corners of the pit. Rocks reduced the excavatable area of TP1 and Level IX was culturally sterile. Excavation of TP2 (N4.5E1) was terminated at 150 cm BS or 207 cm BUDP after

encountering the shelter's bedrock. Also, the last level of TP2 was culturally sterile.

Litho-stratigraphy

For most of the sequence, the sediments were fine grained and consolidated sandy soil (Figure 8-5). Starting at the surface, there was a thin layer of unconsolidated ash (2.5Y 8/1) sediments, Layer I. This layer continued to about ±4 cm BS. The thin ashy layer is a byproduct of recent usage of fire in the shelter by Hadzabe foragers (Matina, personal communication 1992; field observations 1992).

The following layer, II, consisted of a very dark brown (10YR 2/2) to very dark gray (5YR 3/1) compact aeolian sediment. Also, this layer is thin, about 7 cm thick. In some parts, layer III cuts through Layer II. Layer III is a very dark grayish brown (10YR 3/2) consolidated aeolian sediment. This layer ended at ±40 cm BS.

The next layer, IV, went from about 40 cm to ±80 cm BS. Layer IV is a dark grayish brown (5YR 3/2) sediment composed of coarse grained compact sandy soil that is mixed with quartz gravels. The final layer, V, which went from about ±80 cm to 150 cm BS had a consolidated coarse grained dark yellowish brown (10YR 3/4) sediment mixed with fragments of weathered gneiss.

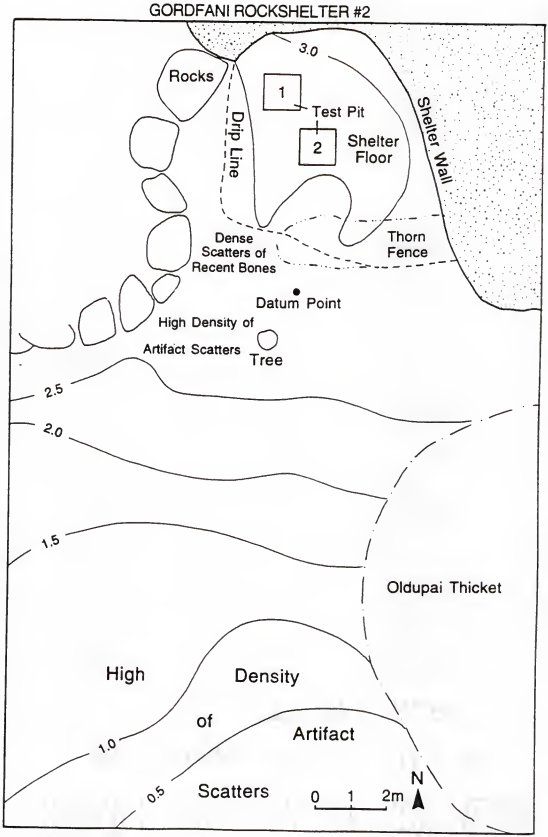


Figure 8-4: Contour Map of Gordfani 2.

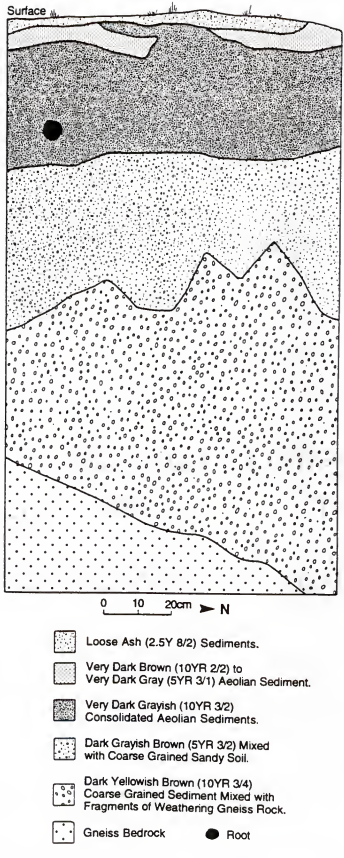

Surface
0 10 20cm
N
Loose Ash (2.5Y 8/2) Sediments.
Very Dark Brown (10YR 2/2) to
Very Dark Gray (5YR 3/1) Aeolian Sediment.
Very Dark Grayish (10YR 3/2)
Consolidated Aeolian Sediments.
Dark Grayish Brown (5YR 3/2) Mixed
with Coarse Grained Sandy Soil.
Dark Yellowish Brown (10YR 3/4)
Coarse Grained Sediment Mixed with
Fragments of Weathering Gneiss Rock.
Gneiss Bedrock
Root

Figure 8-5: Litho-stratigraphy of Gordfani 2.

Radiocarbon Dating

Two charcoal samples from Levels V and VI produced recent and stratigraphically reversed dates of 660 ± 115 BP and < 100 BP (C-13 corrected), respectively. This condition has been caused by either contamination of the dated material or introduction of recent charcoal into lower levels.

Material Remains

Artifact and ecofact content were highest in the thin Layers I and II and lesser in Layer V.

Stone artifacts. TP1 and 2 yielded 2,573 stone artifacts. About 60% of the stone artifacts were recovered from Layers I-III. Although there was a decrease in the number of artifacts recovered as one proceeded in depth, the decrease is not a linear one--sometimes lower spits yielded more artifacts and ecofacts than the upper spits.

The Gordfani 2's lithic assemblages are dominated by angular fragments, followed by flakes, unmodified pebbles and cobbles, cores, and lastly shaped tools. Some of the angular fragments, flakes, and cobbles have evidence of utilization. Five cloudy quartz cobbles have a single striking negative flake scar, possibly suggesting testing for the quality (e.g., flakebility, occurrence of internal flaws) of raw materials before they were transported to the shelter. Eyasi Basin quartz raw materials are characterized by internal cleavages or internal flaws that may cause the intended end

product or even the core itself to break in an unpredictable fashion. Also the appearance of flaws may have deterred knappers from further modification to avoid breakage. Testing the internal quality of a quartz cobble or pebble prior to transporting it to a knapping area would have been not only logical, but also of economical value for prehistoric knappers in the Eyasi Basin.

A few whole and broken hammerstones were recovered from Levels III-VI. As evidenced by a single platform core on a broken basalt hammerstone, some of the broken hammerstones were later used as lithic raw material and were flaked to produce implements.

A total of 212 cores were recovered from Gordfani 2. Twelve kinds of cores are recognized. By far, the most common is the opposed double platform core, forming 31% of all cores at Gordfani 2 (Table 8-2). Although opposed double platform cores are found in almost all levels, the highest density occurs in Levels I to VI. Single platform cores are the second most common category, forming 20.66% of cores. The highest density of single platform cores occurs in Levels I to VI. Radial (11.26%) and bipolar (10.80%) cores are the third most common categories. Radial cores are evenly distributed throughout the sequence while the highest density of bipolar cores occurs in levels III to V. A few Levallois and disc cores also were found (Figure 8-6). Levallois cores occur in Levels IX, X, and XI. Disc cores occur in Levels VIII, X, and XIV, with the highest density in Level VIII.

The Gordfani 2 yielded 133 shaped tools (Figure 8-7). Scrapers are by far the most numerous, forming 49.15% of the shaped tools (Table 8-2). The highest density occurs in Level IV. The most common scraper is the sundry side scraper, followed by the small, convex scraper (Table 8-3). Scraper fragments occur in Levels II to VII, X to XI, and XIII to XIV. If retouched implements were of utilitarian value to prehistoric foragers, then the persistence of scrapers throughout the Gordfani 2 sequence may imply that scraping activities (e.g., hide-scraping, etc.,) were important throughout the occupation history. Overall, scrapers show no significant shifts in shape and degree of formal retouch through time.

Backed tools are the second most common category, forming 21.20% of all shaped tools. The highest density occurs in Levels III to IV and IX to XI. The most common is the curve-backed, comprising 36% of all backed tools. Crescent (24%) is the second most common backed tool and drills or backed awls (20%) is the third. Geometrics (e.g., triangles and trapezes) are missing in the Gordfani 2 sequence.

Other common tool classes are points or percoirs and burins (Table 8-2). Points form 10.17% of all shaped tools. The highest density occurs in Levels IV and IX to X. The unifacial point (83.33%) is the most common of all point tools. Also, a unifacial point was the only shaped tool found in the lowest levels at Gordfani 2. Burins form 14.41%

of all shaped tools. The dihedral burin (82.35%) is the most common burin type. Although burins are absent in Levels VIII and XIV, they are almost evenly distributed elsewhere in the excavated sequence.

The heavy-duty toolkit is represented by core scrapers, core choppers, bifaces, and backed cores (Table 8-2), with core scrapers and backed cores the most common tool types. The highest density occurs in Levels III and IV. Bifaces and core scrapers also occur in the lower levels. The other category of lithic implements is the bifacially modified stone artifacts. This category includes discoids, point rough-outs, and bifacially modified pieces (Table 8-2). The most common type is the discoid. Bifacially modified stone artifacts occur in the five upper levels.

Other stone artifact classes recovered from Gordfani 2 include utilized stone artifacts; blades; flakes; hammerstones; stone discs; and angular fragments (Table 8-2). A utilized chert flake from Level VII has a vitreous lustrous color suggesting evidence of heat treating, however, the flake has two potlids on the flake release surface indicating that the flake may have been subjected to fire after it had been struck from a core. If this scenario is accurate, then the firing was not part of the lithic manufacturing process; usually it is the lithic raw material that is subjected to heat treating before flaking. The vitreous lustrous color of the chert utilized flake may have resulted from later activities such as Hadzabe camp fires at the shelter.

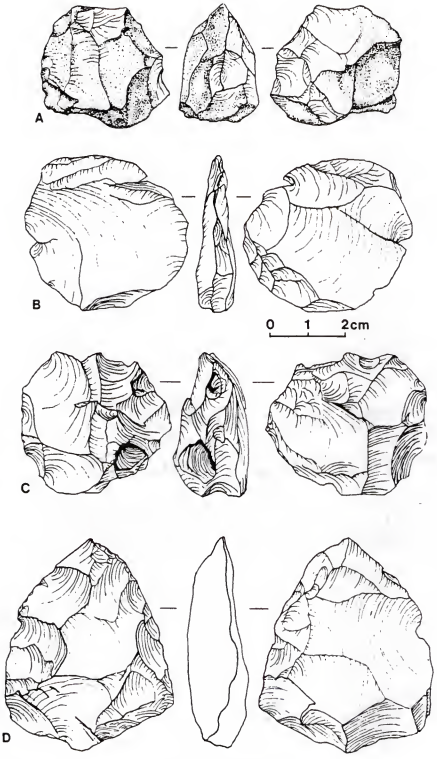


Figure 8-6: Gordfani 2 Artifacts: A, radial core; B, discoid; C, disc core; D, biface.

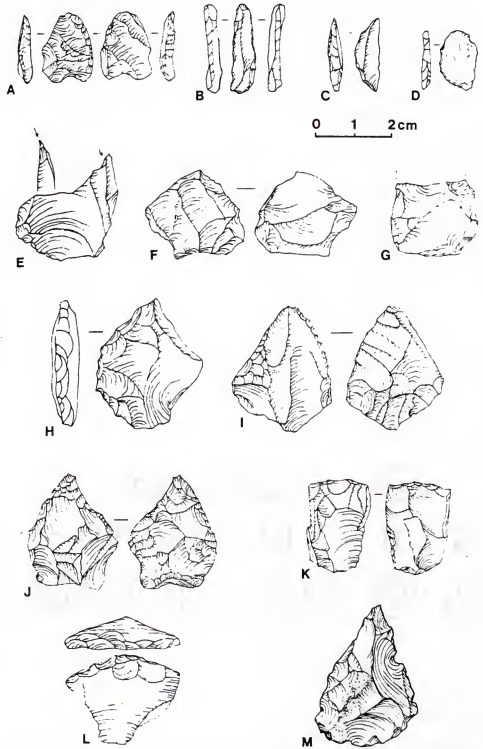


Figure 8-7: Gordfani 2 Artifacts: A, hollow-base unifacial point; B, straight-backed piece; C-D, crescents; E, angle burin; F, Levallois core; G, convex side + sundry side scraper; H, convex side scraper; I-J and M, unifacial points; L, convex end scraper.

Table 8-2: Gordfani 2 Stone Artifacts.

	Levels													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	Total
SHAPED TOOLS															
Backed piece	2		2		3		3		3		2		1		25
								4				2			
Backed fragment	1														3
									1				1		
Scraper	3		5		3		14		4		7		1		56
								5		5		6		1	
														2	
Scraper fragment		1		2		1		1		1					14
									2		2		1		
												1		1	
Outil écaillé	1				1										2
Bec							1								4
									2						
Burin		1		2		3			2		2		2		17
										2		1		1	
													1		
Point							2			1		3		4	12
											1				
Subtotal															133
BIFACIALLY MODIFIED PIECES															
Discoids		1		1		2		3		1					8
Point rough-out			1												2
					1										
Bifacially modified									1						1
Subtotal															11
HEAVY-DUTY TOOLS															
Core scraper		1		2					1				1		7
										1		1			
Core chopper					1										1
Bifaces							1						1		3
									1			1			
Backed cores			1			2		2		2					7
Subtotal															18
CORES															
Bipolar		1		1		5		5		6		1			23
									3				1		
Single platform	9		10		5		3		5		3		1		44
										1		1		3	
											1		2		
														1	
Radial		2		2		1		4		3		2			24
									1		3		1		
												1		3	
														1	
Part-peripheral	2		3			1		2		1			2		14
							2				2				
												1			
Multiple platform		1				2		5		3					15
							2				1		1		
														2	
Pyramidal					5		1		2				1		9
Opposed double platform		12		14		10		9		9		4			66
									2		1		2		
														1	
														1	
Levallois											1		1		3
														1	
Disc									3				1		5
Adjacent double platform											1				2
													1		
Platform/peripheral											1				1
Amorphous			3			1		1							6
									1						
Subtotal															212
UTILIZED															
Flake	4		3		4		4		5		4		1		46
										1		1			
														8	
														3	
														2	
														3	
														1	
														2	
Flake fragment		1		3		2		2			1		1		12
										1		2			
Angular fragment		2		1		3			2			3			13
													2		
Levallois flake									2						2
Blade segment			2							1			1		4
SUBTOTAL															77
OTHER															
Burin spall				3											3
Tool spalls						1									1
Hammerstone			1			2		1							4
Broken hammerstone						2		3							5
Core fragment		1		4		1		2		1		3			16
									1		1		2		
Dimple disc							1								1
Levallois flake	2		1					1		1					5
Blade	2		7		1		2		2		1				19
									3				1		
Subtotal															54
TOTAL	46		69		50		70		60		46		15		505
		29		34		35		20		19		9		4	

Table 8-3: Gordfani 2 Scraper Types

	Levels													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	Total
SCRAPER TYPE															
Small convex	2		1				1		1		2				7
Convex end				2			1					2			5
Convex end+side				2		1			1			1			5
Convex side			1		2										3
Convex double side							1								1
Sundry end				3		1			1				1		6
Sundry end+side			1												1
Sundry side	1		2			2		1	1		1		3	1	12
Sundry double side									1						1
Concave			1		1				1						3
Concavity				2		1			2		1				6
Notch							1					1			2
Convex end+concave							1								1
Convex side+concave		1					1								2
Convergent			1												1
Scraper fragment		1		2		1	1		1			2	2	1	14
TOTAL		3	6	5	16	5	8		2	5	5	8	3	2	70

Human burial. Human skeletal remains were found at the base of Level 7 in each test pit. The skeletal remains were fragile due to the acidic condition of the soil. A fragmentary mandible and teeth of one individual were found together in TP1 on a hard soil matrix underlying a highly weathered gneiss rock. In TP2, individual teeth, possibly of another individual, were found resting on a highly weathered gneiss rock (Figure 8-8). No clear grave profiles that would indicate intentional internment of bodies were observed. Many other human skeletal remains were embedded in the northern walls of both pits. The exposed bones were not in an anatomically "natural" position suggesting that the skeletal remains were not in a primary internment. Although no clear disturbance of the sediments was observed, the "un-natural" anatomical position of the skeletal remains suggest secondary internment. This suggestion is also supported by the un-fossilized to sub-fossilized nature of the skeletal

remains. The bones of animals in Level VII ranged from sub-fossilized to fossilized. Due to time constraints, TP1 and TP2 were not extended northward to uncover more human skeletal remains. Future excavation of Gordfani 2 will clarify the context of Level VII human skeletal remains.

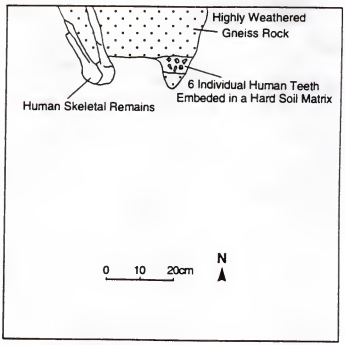


Figure 8-8: Human Skeletal Remains, TP2.

Ceramics. Eleven potsherds were recovered from the Gordfani 2 sequence. All the ceramics occur in the upper six levels, excluding Level II. The highest density (54.55%) occurs in Level III. The tempering materials are quartz gravels and mica. Except for one sherd, all are plain body sherds of different vessels. The former is decorated by incised lines of the PN "Narosura" Ware tradition. This decorated sherd occurs in Level III.

Shell artifacts. Ostrich eggshell is the most common material for making beads. Beads made of ostrich eggshell form 90% of all beads recovered from Gordfani 2. The other raw materials for beads are bivalve shells and stone. Beads occur throughout the upper seven levels, with the highest density in Level VI.

Other artifacts. Three plastic beads and a piece of green glass were recovered from Level I. These items are recent and indicate recent use of Gordfani 2 by Hadzabe foragers. A small chunk of "magadi" salt was recovered from Level VIII of TP2. At present, it is not clear whether the salt was brought from Lake Eyasi (about 5 km) for use here or if it naturally occurs in the shelter sediments. Interestingly, a container with "magadi" salt from Lake Eyasi was also found on the shelter's floor. This more recent salt was brought to the shelter by Matina, a Hadzabe forager who occupied the shelter before and during our research. It remains to be investigated in the future if prehistoric foragers in the Eyasi Basin also utilized the Lake Eyasi soda salt in a way similar to modern foragers.

Ecofacts. Gordfani 2 yielded a small sample of organic remains. All organic materials occur throughout Level I to VII only. No organic material was found below Level VII, possibly because of increasing soil acidity in the lower levels.

Level I yielded recent bone remains of birds and small to medium-size animal groups. Also found were fragments of a

tortoise's carapace. These recent faunal remains are possibly food debris of Hadzabe foragers who occupy the shelter. Level II to VII yielded sub-fossilized to fossilized bones of small to large-size animal groups. Mollusk and ostrich eggshell fragments were recovered from Level I to VII.

Summary History of Gordfani 2

Gordfani 2 reveals a long history of occupation and continues to be occupied by modern foragers. On the basis of Mehlman's (1989) typology, all levels from Level X to the base of the sequence yielded lithic artifacts that are consistent with the "Kisele" MSA Industry at Mumba. Radially reduced cores, such as radial, disc, and part-peripheral cores are present. Also present are Levallois cores. Although the bipolar method of reducing quartz is also present, it plays at best a poor role during this time span. Shaped tools are few. Among the shaped tools, retouched points and scrapers are frequent. Backed tools and burins, although present, are few. The heavy-duty toolkit is rare and is represented by core scrapers and a biface.

Levels VII-IX yielded either MSA/LSA or the late Pleistocene LSA artifactual materials. Radially flaked and platform cores are present. Also present is a Levallois technology. Bipolar cores, however, are missing. Scrapers dominate the shaped tool assemblage followed by backed pieces. Retouched points and burins are the third most

common shaped tools. Levallois flakes and blades are rare. Pottery is missing from these levels. Human skeletal remains were recovered on the base of Level VII (70 cm BS). The "unnatural" anatomical position of the skeletal remains suggest secondary internment and are most likely younger than the associated artifacts. Ostrich eggshell beads occur only in the 60-70 cm BS level. On the basis of the artifacts and ecofacts, the materials from these levels are consistent with either the MSA/LSA transitional "Mumba" Industry or the late Pleistocene LSA "Lemuta" Industry at Mumba.

Levels IV-VI yielded both backed microliths and retouched scrapers among the shaped tools. Other shaped tools include burins, becs, and retouched points. *Outil écailliés* are rare. Bipolar and pyramidal cores are well represented; however, the most common core type is the opposed double platform followed by the single platform. Also present are bifacially modified pieces and heavy-duty tools. Pottery remains are few and undiagnostic. Ostrich and bivalve eggshell beads are well represented. Taken together, the artifactual materials recovered from levels IV-VI are consistent with the Holocene LSA or "Oldeani" Industry (LSA/"Kansyore" pottery) at Mumba.

Judging from the "Narosura" pottery recovered in Level III, the upper levels of the sequence (30-0 cm BS) can be correlated to Bed II at Mumba. Backed awls or drills and scrapers are represented among the shaped tools. Bipolar, pyramidal, single platform, radial, part-peripheral, and

opposed double platform cores are present. Objects for personal adornment, such as ostrich eggshell and bivalve shell beads are more numerous in these levels. Taken together, all these features are consistent with the "Ishimijega" PN Industry as defined by Mehlman (1989). In addition, Level I yielded plastic beads and a piece of glass dating to the last few decades. These items of material culture indicate the continuous utilization of Gordfani 2. Clearly, this demonstrates the importance of rock shelters as habitation locations not only for prehistoric foragers and Neolithic pastoralists, but also for modern foragers.

Survey Area 11

Two of the three rock shelters were test excavated, namely Endanyawishi 1 and 3. Both are overhang shelters that face to the west and have rock paintings (see Chapter 7).

Endanyawishi 1

Endanyawishi 1 has a floor area of about 29 m^2 and is 5.57 m high. Two 1 m^2 test pits were placed on the floor of the shelter (Figure 8-9). A large part of the shelter's floor is covered by exposed bed rock. The two test pits were placed close to each other where exposed bedrock was absent. Both test pits were excavated to 45 cm BS or 235 cm BUDP for TP1 (N2E2.5) and 171.5 cm BUDP for TP2 (N0E3.5).

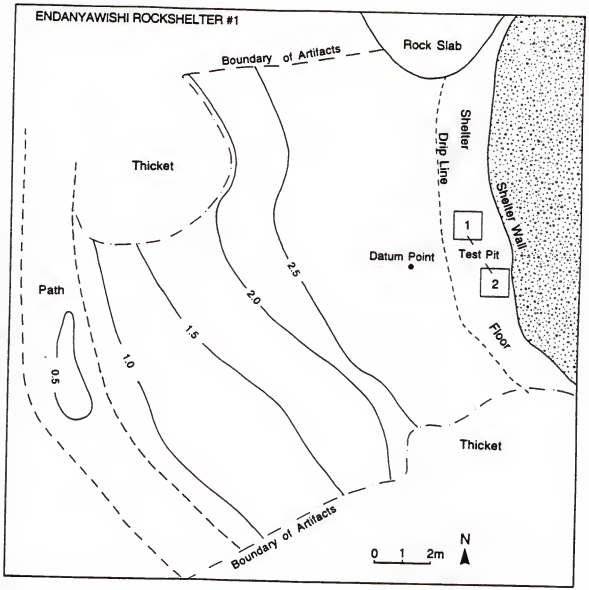


Figure 8-9: Contour Map of Endanyawishi 1.

Litho-stratigraphy

The deposit at this shelter is shallow because of the underlying bedrock. It consists of a single dark brown sandy soil mixed with termite clay soil. Nevertheless, it was

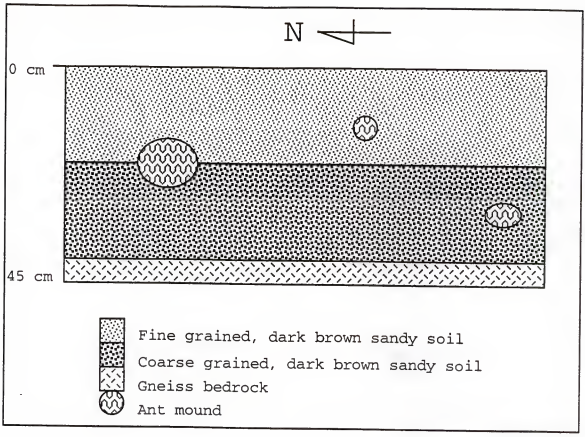


Figure 8-10: Litho-stratigraphy of Endanyawishi 1.

possible to divide the deposit into an upper and lower unit based on soil grain size (Figure 8-10). The upper unit is composed of fine grained dark brown sandy soil while the lower units consists of coarse grained dark brown sandy soil. Termite activity in the form of small mounds and holes was noted throughout the sequence. Because of the termite clay soil, excavation of Levels III to IV (20-40 cm BS) using trowels was practically impossible. Instead, the two levels were excavated using geological hammers. With the exception of a few bone fragments recovered in Level III, no other materials were recovered from these two levels. The observed termite activity may have moved the bone fragments in Level

III down from the upper levels. Below level IV, the underlying bed rock became visible and excavation of this shelter was concluded at about 45 cm BS.

Material Remains

The scarcity of artifacts suggest that the shelter had either a very brief period of occupation or the upper sediments of the litho-stratigraphic sequence have been deflated by erosion. The latter is supported by the high density surface scatters of stone artifacts on the slope, about 6.10 m from the shelter's drip line (see Chapter 7).

Stone artifacts. Eighty-six stone artifacts were recovered from the excavation. A total of 3 shaped tools were recovered, representing 3.5% of the assemblage. The shaped tools include a *outil écaillé*, curve-backed piece, and a sundry side scraper (Table 8-4). Only 3 shaped tools occur in Level I. Only five cores are present, forming 8.14% of the assemblage. The core types represented include single platform, part-peripheral, radial, and multiple platform cores (Table 8-4). The two single platform cores have a combination of fresh and moderately abraded flake scars. Moreover, the moderately abraded scars have a moderate to heavy patination while the fresh scars lack any patination. This may suggest re-use of stone artifacts. Most artifacts are made of cloudy quartz (73.25%), clear quartz (18.60%), obsidian (7.00%), and quartzite (1.15%).

Table 8-4: Endanyawishi 1 Stone Artifacts.

	Levels I	II	III	IV	Total
SHAPED TOOLS					
Backed piece	1				1
Scraper	1				1
Outil écaillé	1				1
Subtotal					3
CORES					
Part-peripheral	1	1			2
Radial	1				1
Single platform	1				1
Multiple platform	1				1
Subtotal					5
UTILIZED					
Flake	3	1			4
Blade	1				1
Subtotal					5
OTHER					
Blade	1				1
TOTAL	10	4			14

Ecofacts. A few fragments of animal bones were recovered from Level I to III. Taking into account the termite activity observed in Level III, it is possible that the few bones found in this level may have come from the upper Level II. Also found were snail shell fragments.

Plant remains. Fragments of baobab fruit shell were recovered from Level II. These may date to the past few decades and were probably discarded at this shelter as food debris by the Hadzabe foragers. The baobab fruit debris is the only evidence that indicates recent utilization of this shelter by Hadzabe foragers.

Summary history of Endanyawishi 1

This shelter had probably only a brief period of occupation. The lithic assemblage is too small and

nondescript to attempt to place it in the Eyasi Basin archaeological sequence. Nonetheless, on the basis of the paintings (see Chapter 7), the few formal tools and cores from the excavation and the surface findings (including plain pottery fragments) on the shelter's slope, the shelter was probably occupied by foragers of the late Pleistocene/early Holocene. Moreover, the occurrence of baobab shells indicates the recent utilization of the shelter by Hadzabe foragers.

Endanyawishi 3

This is an overhang shelter facing west. The floor area is about 62.92 m^2 and the shelter is about 12 m high. Only one 2 x 1 m test pit was opened at this shelter. TP1 (N1E5) was located on the shelter's floor and was excavated to 80 cm BS or 240 cm BUDP.

Litho-stratigraphy

Three stratigraphic layers are discernible at Endanyawishi 3. Layer I consisted of dry, dark grayish brown, fine grained sandy sediments, mixed with ash. The sediments were loose and digging was difficult. This layer continued to about 40 cm BS. Layer II consisted of a dark brown sediment low in ash content and more consolidated. This layer was 35 cm thick and ended at about 75 cm BS. Layer III went from about 76 cm BS to bedrock, 80 cm BS. This layer had a compact sandy matrix mixed with weathered

gneiss fragments. Plant roots occurred throughout the stratigraphic sequence.

Radiocarbon Dating

A charcoal sample from Level VI produced a date of 470 ± 170 BP (C-13 corrected). This date is too young for the recovered artifacts, suggesting that the charcoal sample is recent and, therefore, intrusive.

Material Remains

Artifact and ecofact content was highest in Layer I and lowest in Layer III.

Stone artifacts. A total of 597 stone artifacts was recovered from the test pit. Angular fragments dominate the assemblage, forming 37.70%. Shaped tools are few, forming only 5.20% of the assemblage (Table 8-5). Backed pieces are by far the most numerous, forming 42% of the shaped tools (Figure 8-11). With the exception of a triangle in Level VIII, all the other backed pieces occur in Level I to IV. The highest densities occur in Levels II and VI. The most common type is the curve-backed piece, followed by the straight-backed piece.

Scrapers are the second most common category, forming 38.71% of the shaped tools. With the exception of two scrapers in Level VIII, the rest occur in Levels I, III, and IV. The highest density occurs in Levels I and IV. Most scrapers are of the sundry side type. Small convex scrapers,

however, are missing. The other shaped tools are one unifacial point, a bec, and five *outil écaillé* (Figure 8-11). The retouched point occur in Levels IV and the bec in Level III. The *outil écaillés* occurs in Level II to VI with the highest density in Level VI.

Bifacially modified pieces are also few as well as the implements of the heavy-duty toolkit. The bifacially modified category is represented by four discoids that occur in Levels I, IV, and VI. The heavy-duty toolkit is represented by two core scrapers occurring in Levels II and VI.

Compared to shaped tools, cores are numerous, forming 15% of the lithic assemblage. The highest densities occur in Levels II to IV. The most common core type is the divers single platform, forming 21.35% of all cores. The bipolar core (20.22%) is the second most common core type followed by the opposed double platform (19.10%).

Other important lithic artifacts include three blades, a hammerstone, and two pestle rubbers. The blades occur in Levels II, VI, and VIII, the hammerstone in Level IV, and the pestle rubbers in Levels VI and VII. The most common lithic raw material is cloudy quartz (69.35%). Other lithic raw materials include clear quartz (23.62%), obsidian (2.51%), chert (2.51%), quartzite (1.84%), and basalt (0.17%).

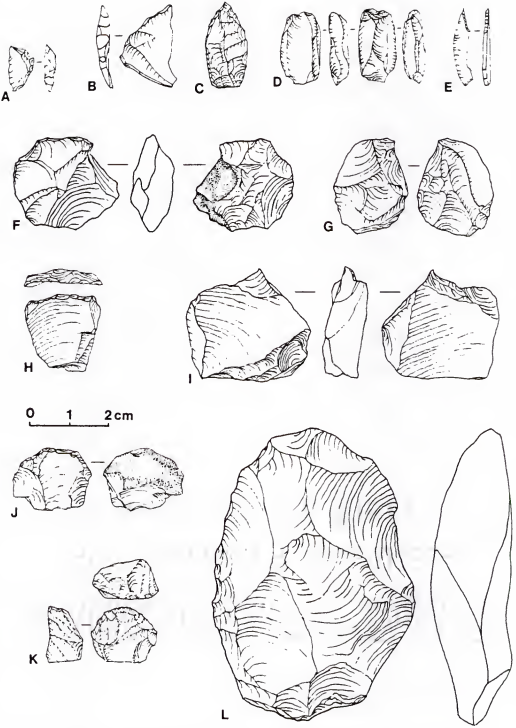


Figure 8-11: Endanyawishi 3 Artifacts: A-B, triangles; C, curve-backed piece; D, opposed double platform core; E, backed drill; F, radial core; G, small biface; H, straight-backed piece; I, bec; J-K, convex side scraper; L, biface.

Table 8-5: Endanyawishi 3 Stone Artifacts.

	Levels								
	I	II	III	IV	V	VI	VII	VIII	Total
SHAPED TOOLS									
Backed	2	5	1	4				1	13
Backed fragment	1			1		2			4
Scrapers	4		2	4				2	12
Scraper fragment	2		2				1		5
Outil écaillé		1		1		2		1	5
Bec				1					1
Point					1				1
Subtotal									41
BIFACIALLY MODIFIED PIECES									
Discoid	2				1		1		4
Subtotal									4
HEAVY-DUTY									
Core scraper		1					1		2
Subtotal									2
CORES									
Bipolar	3	3	3	3	1	5			18
Single platform	5	2	7	4	1	2	2		23
Radial	1	3	1	1	2				8
Part-peripheral		2			1	3	1	1	8
Multiple platform	1					1		1	3
Opposed double platform		6	3	8	1			1	19
Disc		1	1	1	1				4
Platform peripheral		1	1						2
Amorphous				1					1
Subtotal									86
UTILIZED									
Flake	6	8	4	1		4		2	25
Flake fragment		1		1					2
Angular fragment		3	4			3			10
Subtotal									37
OTHERS									
Hammerstone				1					1
Core fragment	1	1	3			2	1		8
Blade		1				1		1	3
Burin spall	1	1						1	3
Tool spall		1							1
Pestle rubber						1		1	2
Subtotal									18
TOTAL	29	43	32	34	8	26	5	11	188

Human burial. From the floor of Level VI we realized that skeletal remains in the southwest corner of the pit were fragile. Therefore, extra care was given in exposing these bones. Using a combination of dental picks, wooden tools, and a range of soft brushes, we exposed a complete sub-

fossilized human skull in the southwest corner of the pit. Broken femurs were exposed on the floor in the southeast corner. All the bones were embedded in the walls of the test pit and below Level VII. Although we observed no major sediment disturbance (apart from one "krotovina") in the test pit, the position of the cranium relative to the axial skeleton bones indicates that the human skeletal remains are not in their primary context, suggesting that they are intrusive. All the skeletal remains were pedestaled and left *in situ*. Further excavation of the shelter is required to understand not only the context of the skeletal remains, but also burial practices of prehistoric people in the Eyasi Basin.

Ceramics. Pottery remains are very few as only four pieces were recovered from Endanyawishi 3. These were found in Levels II and IV. With the exception of one sherd, the rest are plain body sherds. The decorated sherd is a rim sherd that occurs in Level IV. This rim sherd is decorated by punctate rows banded by incised lines. This decoration style is typical of the PN "Narosura" Ware tradition.

Shell artifacts. Endanyawishi 3 yielded shell artifacts that range from complete and finished beads to broken and unfinished beads. There are was 18 disk-shaped beads, one drilled but unfinished disc shaped shell bead, two drilled but unshaped shell fragments, and four finished and unfinished bead fragments. The sample indicates beads were manufactured locally at the shelter. Bead blanks or shell

fragments were drilled before being shaped into disc beads. Shell artifacts occur in all levels, except Levels III and IV. The highest density occurs in Level V, forming 52% of all recovered shell artifacts. Ostrich eggshell (92%) is the most common raw material for making beads. The other raw material utilized at this shelter was stone (8%).

Other artifacts. Thirteen modern plastic beads with 8 different shapes and 6 different colors (red, light blue, dark blue, yellow, white, and green) were collected from the surface. Also, Level I yielded 10 modern plastic beads that belong to three different types and three different colors (white, blue, and green). The edges of some of the cylindrical modern beads have been cut and then polished, possibly to increase the size of the hole for threading. Some of these modified modern plastic beads resemble prehistoric eggshell beads. The occurrence of modern beads at this shelter indicates its recent utilization by Hadzabe foragers.

Pigments. Three pieces of ochre were recovered from the test excavation. A piece of red (10R 5/2) pigment, weighing 0.4 gm was recovered from Level I. Two pieces of dusky red (10R 3/3) pigment, weighing 10.7 gm, were recovered from Level VII. Since many of the rock paintings at this shelter are in red color (see Chapter 7), it is most likely that the recovered red pigment minerals were either used or brought to the shelter as coloring raw materials for the paintings.

Alternatively, the pigment mineral could have been brought to the shelter for other ritual activities and body decorations.

Ecofacts. A few bone fragments were recovered throughout the excavated levels. In Level I the bone fragments were non-fossilized, while those in lower levels were sub-fossilized. Bone fragments of small-sized animals and birds occur in Level I. In the lower levels, the bone fragments range from small-sized to large-sized animals. Also represented are a few fragments of land snail shells. These occur only in Level VI.

Summary History of Endanyawishi 3

The occupations of this shelter ranges from prehistoric times to the present. The recent occupation of this shelter is indicated by the plastic beads recovered from the surface and Level I of the test pit.

Judging from the "Narosura" Ware pottery recovered in Level IV, the upper levels of Endanyawishi 3 sequence (40-0 cm BS) can perhaps be correlated to the Bed II PN "Ishimijega" Industry as defined by Mehlman at Mumba. The lower levels, with human burials in Levels VII to VIII may be correlated with the upper Bed III horizon at Mumba. The lithic assemblage composed of scrapers, backed pieces, retouched points, pestle rubbers, *outil écaillé*, becs, and others are consistent with the Holocene ceramic LSA that is known at Mumba as the "Oldeani" Industry (LSA/"Kansyore"

pottery). Pottery, however, is missing at Endanyawishi 3 due perhaps to the small volume of excavated deposit.

Because of the presence of stone artifacts, human and animal bones, and beads on the shelter bedrock, it is clear that before occupation the shelter was devoid of sediments. Concurrent with initial occupation, sediments slowly accumulated, mostly of aeolian origin.

Survey Area 12

Three rock shelters, namely Qhadenaqwete 1, 2, and 3, were test excavated in this survey area. All three shelters contain rock paintings (see Chapter 7).

Qhadenaqwete 1

This is an overhang shelter facing west with a floor area of about 130.56 m^2 and a height of 9.50 m. The base of the shelter is on the mica schist rock that might have resulted from either the shearing of the uplifted block or from weathering of the less resistant rock. Because of the exposed bedrock that covers a large part of the shelter floor, only one test pit could be excavated. Placing a test pit on the slope of the shelter proved difficult because of the steep slope. Moreover, the shelter slope is dominated by exposed gneiss rocks. TP1 (N2E5.8) is a 2 x 1 m (2 m^2) pit and was excavated to 30 cm BS or 50 cm BUDP.

Litho-stratigraphy

This shelter has a shallow stratigraphic sequence. Only two stratigraphic layers could be identified. Layer I is a loose, dark grayish aeolian sediment mixed with ash. This layer is about 10 cm thick. Layer II was somewhat more consolidated, dark grayish aeolian sediment mixed with ash and fragments of a weathering gneiss bedrock. This layer continued to about 30 cm BS. Because of the shallow deposit, recent human occupation of the shelter has likely mixed with the archaeological materials.

Feature. One hearth was exposed in Level I on the southeast corner of the pit. This hearth covered an area of 0.30 m^2 and was characterized by a high concentration of charcoal fragments and ashes. The hearth continued into Level II and disappeared at 20 cm BS. This was excavated separately. The artifactual material recovered from this feature includes lithic angular fragments, a plain body sherd, and two ostrich eggshell fragments. The animal remains include burnt bones of birds and small-sized animals. Also recovered were numerous charcoal fragments that seem to be recent. The cultural material accumulated in the hearth does not appear to be different from those in Levels I and II.

Material Remains

Because of the shallow deposit, this shelter yielded very few items of material culture.

Stone artifacts. A total of 175 stone artifacts was recovered from the test pit. The most common lithic artifacts are angular fragments (64%) followed by flakes (33.71%). Shaped tools are rare, forming 1.71% of the lithic assemblage. Shaped tools include a small convex scraper, a crescent, and a convex side and concave combination scraper. All the shaped tools occur in Level II. Cores are rare, comprising only 1.71% of the assemblage. The recovered cores include an opposed double platform, radial, and a divers single platform core. The latter occurs in Level III and the former occur in Level II. Cloudy quartz (85.72%) is the most common lithic raw material. Other lithic raw materials include clear quartz (11.43%), chert (1.71%), and obsidian (1.14%).

Ceramics. The only pottery recovered is the plain body sherd associated with the feature.

Shell artifacts. The only shell artifacts recovered from this pit are the two ostrich eggshell beads associated with the feature.

Other artifacts. Four plastic beads were recovered from Level I. The occurrence of modern beads at the shelter indicates recent utilization of the shelter by Hadzabe foragers.

Ecofacts. A few bone fragments of birds and small-sized animals were recovered from Level I and the feature. Many of the bone fragments from the feature were burnt. Also, the feature yielded fragments of ostrich eggshell.

Plant remains. Numerous fruit seeds were recovered from Level I. No scientific identification of the fruit remains has been done. The seeds are modern and possibly were utilized by Hadzabe.

Summary History of Qhadenaqwete 1

To avoid the danger of squeezing too much blood from too few artifacts, a meaningful summary history of Qhadenaqwete 1 is difficult. Nevertheless, on the basis of the occurrences of the art of the "Hunters" and "Bantu" at the shelter (see Chapter 7), I suggest that the shelter was utilized by both late Pleistocene/early Holocene foragers and Neolithic pastoralists. The occurrence of plastic beads and recent fruit debris indicate the modern utilization of the shelter by Hadzabe foragers.

Qhadenaqwete 2

Qhadenaqwete 2 is an overhang shelter also facing to the west. The shelter is about 20 m east and 40 m north of Qhadenaqwete 1. The floor area is about 47.84 m^2 and the shelter is 8 m high. Two test pits were excavated. One was placed inside the floor and the other at the shelter drip line (Figure 8-12). TP1 (N5.6E3.8) was a 1 m^2 pit and was

excavated to 40 cm BS or 185 cm BUDP. TP2 (N10.7E3.8) was a 2 x 1 m pit and was excavated to 70 cm BS or 222 cm BUDP. Although excavation of TP2 started as a 2 m^2 area, it ended as a 3 m^2 area after an extension of a 1 m^2 area to expose human skeletal remains that we came across in Level V. However, all the recovered material from the 2 m^2 and 1 m^2 areas were bagged together according to the arbitrary levels.

Litho-stratigraphy

Qhadenaqwete 2 has a shallow stratigraphic sequence. The upper layer, I, is composed of unconsolidated dark grayish (5YR 4/1), coarse grained sediment mixed with ash and fragments of gneiss. The gneiss fragments are the byproduct of exfoliation or mechanical weathering of the rock shelter surface. This layer was about ±5 cm thick. The following layer, II, was a consolidated dark grayish (5YR 4/1), coarse grained sandy soil, mixed with ash. Layer II went to about 40 cm BS. Lastly, Layer III went from about ±40 to 70 cm BS. Layer III was a dark brown (7.5YR 3/2), coarse grained sandy soil mixed with fragments of a weathering gneiss bedrock.

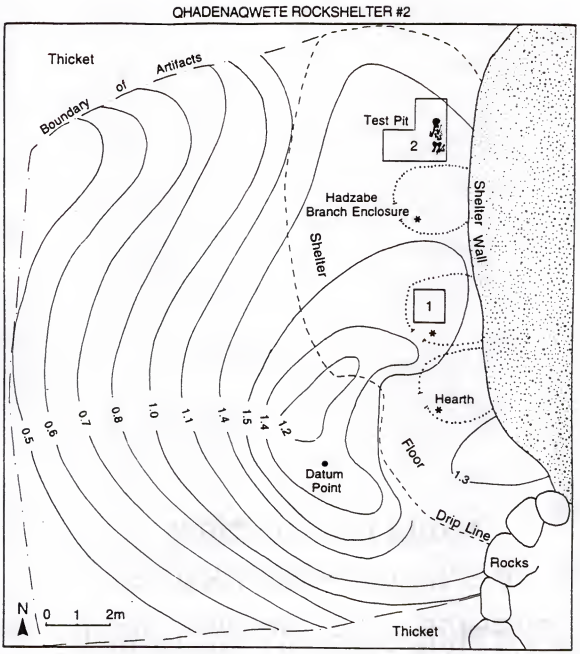


Figure 8-12: Contour Map of Qhadenaqwete 2.

Material Remains

The highest density of artifacts and ecofacts occurred in Layer I and the upper part of Layer II.

Stone artifacts. A total of 1,957 stone artifacts was recovered from Qhadenaqwete 2. Most of the lithic artifacts (97%) occur in Levels I to III. The only stone artifacts that occurred below Level V were the six angular fragments that were recovered in Level VI in direct association with the human skeletal remains. All six angular fragments came from the pelvis area of the skeleton. They do not differ from other recovered angular fragments.

Angular fragments are the most common artifacts, forming 62.44% of the total lithic assemblage. Flakes were the second most common, forming 29.59% of all recovered lithic artifacts. Only four blades and one utilized levallois flake were recovered. The utilized levellois flake was recovered from Level III and the blades from Levels I, II, and IV (Table 8-6).

Shaped tools are very few, forming only 0.82% of the assemblage. The highest density of shaped tools occurred in Level II (Table 8-6). The most common category of shaped tool is the scraper, forming 56.25% of all shaped tools (Table 8-6). The highest density of scrapers occurred in Level II. The small convex scraper was the most common scraper type, forming 33.33% of all scrapers. Small convex scrapers occur in Levels I and II. Other types of scrapers include convex side, sundry side, concavity, and sundry combination scraper.

Backed tools was the second most common tool category, forming 31.25% of all shaped tools (Table 8-6). The most

common types are the curve-backed and straight-backed pieces, each comprising 40% of all backed tools. The other backed tool is the crescent (20%) that occurs in Level I. An angle burin occurring in Level II and a bec occurring in Level I are the only other shaped tools apart from scrapers and backed pieces. Two core scrapers occurring in Levels II and IV are the only artifacts of the heavy-duty toolkit.

Table 8-6: Qhadenaqwete 2 Stone Artifacts.

	Levels				
	I	II	III	IV	Total
SHAPED TOOLS					
Backed	2	2		1	5
Scrapers	2	6	1		9
Scraper fragment	2	1	1	1	5
Bec	1				1
Burin		1			1
Subtotal					21
HEAVY-DUTY					
Core scraper				1	1
Subtotal					1
CORES					
Bipolar	1	4	4	2	11
Single platform	1	2	2		5
Radial		2			2
Part-peripheral		1			1
Multiple platform	1		1		3
Opposed double platform	3	2			5
Disc	1	2	2		5
Adjacent double platform		1			1
Subtotal					33
UTILIZED					
Flake	2	3	3	1	9
Levallois flake			1		1
Subtotal					10
OTHERS					
Blade	2	1		1	4
Subtotal					4
TOTAL	19	28	14	8	69

Cores form 1.64% of the lithic assemblage. The highest density occurs in Level II. Nine core types occur and the most common is the bipolar, forming 34.38% of all cores. Bipolar cores occur in Levels I to IV, with the highest

density in Levels II and III. The second most common type is the disc core, forming 15.63% of all cores. Other represented cores include part-peripheral (3.13%), radial (6.25%), divers single platform (12.50%), single platform (3.13%), opposed double platform (12.50%), adjacent double platform (3.13%), and multiple platform (9.38%) cores.

Cloudy quartz (86.1%) is the most common lithic raw material. The other utilized lithic raw materials are clear quartz (13.23%) and quartzite (0.66%).

Human burial. At the base of Level V, the western half of the pit reached the bedrock. However, we observed bone remains embedded in the floor of Level V in the eastern half of the pit after we removed two large rock slabs that appeared from Level III to V. Since we had a little more time at the end of the research, we decided to continue excavating the eastern half of the pit.

Level VI was carefully and slowly excavated with the goals of exposing and identifying the bone remains. Accordingly, we undertook an excavation procedure using dental picks, wooden tools, and a range of soft brushes instead of trowels. At 52.5 cm BS, we identified the bone remains to be human. We observed that some of the bones were embedded into the northern wall. On the basis of the anatomical positions of the exposed limb bones, we suspected that the skeletal remains were undisturbed and in their primary internment position. Therefore, we decided to extend the 1 m^2 pit northward into a 2 x 1 m pit. The annexed 1 m^2

pit was then excavated by normal procedures, but more carefully to 50 cm BS. More rock slabs were removed from the top before the bones were visible. From here, the excavation of human skeletal remains continued. The skeleton was completely exposed at 70 cm BS.

The human skeleton was complete and all bones were in an anatomical position. The skeleton was oriented with the head to the north and the body placed on its right side, facing west (Figure 8-13). The leg and arm bones were flexed. The left hand has a flexion angle of 45° and the right hand a flexion angle of about 20°. The right foot has a flexion angle of 30°.

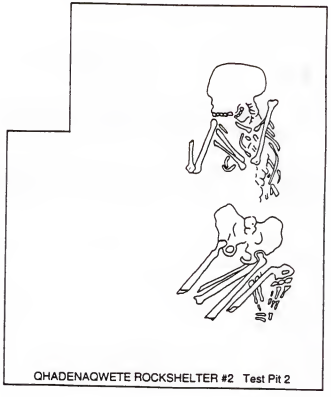


Figure 8-13: The Human Skeletal Remains, Qhadenaqwete 2, TP2.

Judging from dentition, cranial suture, pubic symphysis surface, skull size, and the robustness of the bones, our preliminary observations suggest that the skeletal remains are of a mature adult (35-50 years old) male individual with no evidence for either pathological conditions or signs of osteological trauma.

Since all the bone joints were in their articulated positions, the skeleton is in its primary context. The body was interred as a single interment. It seems that the body was placed between two rock slabs that dip east at 40° and latter covered by rocks and sand, possibly to prevent it from being exhumed by scavenger animals or as a marker. Latter deposition processes at the shelter covered the piled stones as the stones were not visible on the surface. The skeletal remains were left *in situ* for future research, and the excavated pit back-filled.

Ceramics. Pottery remains were rare. Only two plain body sherds were recovered from Levels II and III in TP2.

Shell artifacts. At this shelter, artifacts such as beads made of eggshells or animal shells were missing; however, one bead made of stone was recovered from Level II in TP2.

Pigments. A total of 22 pieces of white (10YR 8/1) pigment weighing 23.3 gm were recovered in Levels I to IV. The highest density occurred in Level III, forming 54.54% of all pigment material at this shelter. The pigment probably formed a major component of the "dirty white" color that was

used to paint the art of the "Bantu" that is found at this shelter (see Chapter 7). It is also possible that the pigment could have been used for other cultural activities such as ritual and body decorations.

Ecofacts. The faunal remains were sparse, occurring as fragments of probably a few individual animals. The fragmentary remains occur in Level I to III and represent both birds and small-sized mammals. Some of the bone fragments are burnt. Snail shell fragments occurred in Level III of TP2, however, it is not clear if they were introduced at the shelter as food or were deposited by natural means.

Summary History of Qhadenaqwete 2

Like Qhadenaqwete 1, it is difficult to summarize the occupational history of Qhadenaqwete 2 because the recovered diagnostic artifacts (e.g. shaped tools) are meager. The scarcity of shaped tools can be attributed to either a relatively short period of occupation or that tools were discarded away from the shelter. On the basis of the occurrence of the flexed human skeletal remains in Levels V to VII, the sediments of these levels can be correlated to the upper Bed III at Mumba. Flexed, west facing, and north-south oriented skeletal remains were excavated from the upper Bed III at Mumba by Kohl-Larsen in the 1930's. The artifactual materials associated with upper Bed III at Mumba have been defined by Mehlman as Holocene ceramic LSA, locally known as the "Oldeani" Industry (Mehlman 1989). Therefore,

the artifactual materials and the human skeleton in Levels V to VII at Qhadenaqwete 2 may represent early Holocene foragers. This suggestion is also supported by the occurrence of the art of the "Hunters" (see Chapter 7). On the basis of the occurrence of white pigments in Levels I to IV, that was possibly used as the "dirty white" paint for the art of the "Bantu", I assume that Neolithic farmers or pastoralists also utilized the shelter. Although no items of Hadzabe material culture or food debris were recovered from the excavation, the occurrence of branch enclosures on the shelter floor (Figure 8-13, also see Chapter 5) and ethnographic inquiries (Madulu personal communication 1992) indicate this shelter was occupied by a Hadzabe family in the rainy season of 1990. Therefore the occupation history of Qhadenaqwete 2 ranges from late Pleistocene/early Holocene times to the present.

Qhadenaqwete 3

This shelter rests on the same hosting block as Qhadenaqwete 2. The shelter faces to the west and has a floor area of about 46.50 m^2. It is about 9 m high. Because of the exposed bedrock, only one 2 x 1 m test pit could be placed on the floor of the shelter (Figure 8-14). TP1 (N2 E3.01) was excavated to 50 cm BS or 70 cm BUDP.

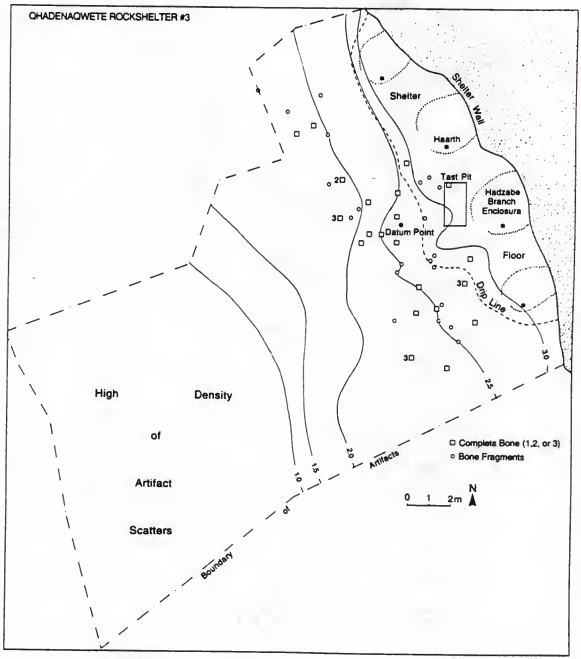


Figure 8-14: Contour Map of Qhadenaqwete 3.

Litho-stratigraphy

The deposit at this shelter is also shallow, and composed of three layers only. Layer I was an unconsolidated fine grained, dark grayish (5YR 4/1) aeolian sediment. This layer was 10 cm thick and was relatively disturbed by recent occupation of the shelter by Hadzabe foragers (see Chapter 5). The following Layer, II, was a consolidated coarse grained, dark grayish sandy soil mixed with fragments of gneiss bedrock. This layer went to about 40 cm BS. Lastly, Layer III was composed of consolidated dark brown (7.5YR 3/2), coarse grained sandy soil mixed with fragments of a weathering gneiss bedrock. This layer ended on the bedrock, 50 cm BS.

Material Remains

The volume of the excavated deposit was small because of the underlying bedrock that we encountered following Level I in the northeast and northwest corners of the pit. Consequently, the sample of the recovered material is also small, although material remains were recovered from all the excavation levels.

Stone artifacts. A total of 546 stone artifacts was recovered from the test pit. Angular fragments are the most common artifacts, forming 64.65% of the lithic assemblage. Flakes were the second most numerous lithic category forming 26% of the assemblage.

Shaped tools are very rare, forming only 0.92% of the lithic assemblage. The majority of the shaped tools occur in Level III. Shaped tools are absent in Levels I and V. The backed tool is the most common category, forming 60% of all shaped tools. The curve-backed piece is the most common type, forming 66.66% of all backed tools. The other backed tool is the angle-backed piece (33.33%). Scraper tools are rare, forming only 40% of all shaped tools. Only two scrapers were recovered: a convex side and concave combination and a sundry end and side scraper. The heavy-duty toolkit is represented by three core scrapers. Two of the core scrapers were recovered from Levels II and V.

Cores are very rare, forming only 1.65% of the lithic assemblage. The highest density occurs in Level V. The bipolar core is the most common type, forming 44.44% of all cores. The second most common core type is the opposed double platform, forming 22.22% of all cores. Other recovered cores include the divers single platform (11.11%), part-peripheral (11.11%), and the multiple platform core (11.11%). The most common utilized lithic raw material is cloudy quartz, forming 93.40% of all lithic raw materials. Other utilized lithic raw materials are clear quartz (4.40%) and obsidian (2.20%).

Shell artifacts. Artifacts made of shell materials were very rare. Two ostrich eggshell beads were recovered in Level IV.

Other artifacts. Seven plastic beads were recovered in Level I, indicating utilization of the shelter by Hadzabe foragers.

Ecofacts. A few fragments of animal bones and snail shells were recovered in Level II, however, on the floor and slope of the shelter, we recorded numerous whole bones and the fragments of an almost complete cow. Ninety-five percent of the rib bones and short bones (e.g., foot bones) were whole, while all long bones, pelvis, and cranial bones were largely broken. According to our informants, this dead cow was consumed by a Hadzabe family that lived at this shelter in the 1991 rainy season. The dead cow was given to the Hadzabe family by a pastoralist family that live nearby, at the village of Endahakichandi. Figure 8-16 shows the distribution of the bones as discarded by the Hadzabe family. More than 75% of the utilized bones were discarded beyond the drip line (see Chapter 5 for details).

Summary History of Qhadenaqwete 3

It is very hard to reconstruct the history of occupation at Qhadenaqwete 3 based on the recovered artifactual materials. Nevertheless, the lithic and rock art (Chapter 7) data show that Qhadenaqwete 3 was briefly occupied, possibly by early Holocene foragers. Recent utilization of this shelter by Hadzabe foragers also is evident.

Survey Area 14

Only one rock shelter, Endahakichandi 2b, was test excavated in this survey area. This shelter is straight-faced with a floor area of about 217.33 m^2. The shelter faces to the west and has a height of about 8.70 m. Only one 2 x 1 m test pit was excavated at this shelter. TP1 (N0E7) was placed at the shelter's slope and excavated to 70 cm BS or 205 cm BUDP (Figure 8-15). At Level VI (50-60 cm BS), TP1 was reduced to 1 m^2 to avoid exposing further the human skeletal remains due to time constraints. The exposed skeletal remains were pedestaled during excavation of Levels VI and VII and were left *in situ*.

Litho-stratigraphy

Four stratigraphic layers were recognized at this shelter. The first layer, I, was a fine grained, unconsolidated dark grayish (5YR 4/1) aeolian sediment mixed with ash. Controlling spits depths was difficult because of the fine grained and loose aeolian sediments. Near the shelter wall, we observed recent disturbances of this layer by both humans and animals. Layer I continued to about 25 cm BS.

The following Layer, II, consisted of fine grained, unconsolidated grayish brown (10YR 5/2) aeolian sediment. This layer was about 15 cm thick ending at 50 cm BS. Layer III was a consolidated, fine grained brownish (7.5YR 5/4)

aeolian sediment. This layer ended at ±63 cm BS. Layer IV consisted of consolidated, coarse grained brownish sandy soil mixed with fragments of weathering gneiss rock. This layer ended at bedrock, about 70 cm BS.

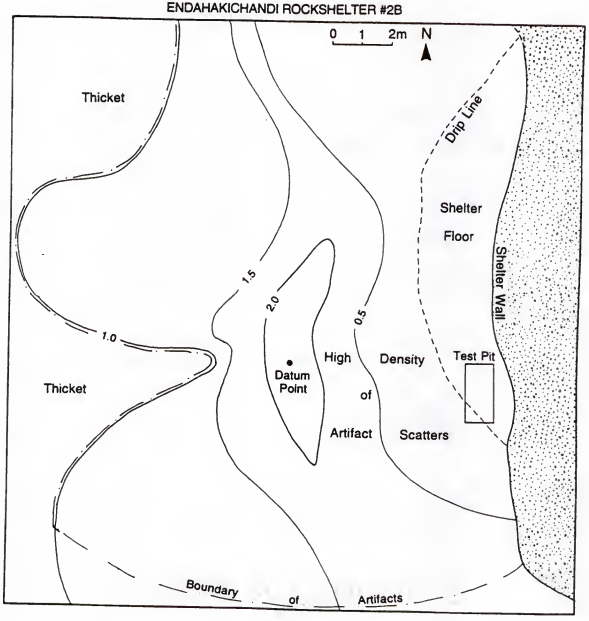


Figure 8-15: Contour Map of Endahakichandi 2b.

Radiocarbon Dating

A radiocarbon date of 3,090 ± 380 BP (C-13 corrected) was recorded on a charcoal sample recovered from Level VI. This date is reasonable and acceptable, indicating either a Holocene LSA or PN cultural stage for the Endahakichandi 2b artifacts.

Material Remains

Artifact densities were high in all stratigraphic layers except Layer IV. The material remains included stone artifacts, shell artifacts, faunal remains, and recent items of Hadzabe material culture.

Stone artifacts. A total of 6,394 stone artifacts was recovered from the test pit. Angular fragments dominate, forming 53.20% of the total lithic assemblage. Flakes are the second most common artifact category, forming 32.36% of the lithic assemblage. Also well represented are unmodified cobbles and pebbles, forming 1.16% of the assemblage.

Shaped tools are very sparse, comprising only 1.61% of the assemblage (Figure 8-16; Table 8-7). The highest density occurs in Level III and IV. The most common category is the backed tools, representing 57.28% of all shaped tools. The highest density of backed tools occurs in Level IV. The most common backed tool is the curve-backed (39%) followed by crescent (27.12%) and straight-backed piece (18.64%). Other backed tools include trapeze (3.40%), triangle (1.70%),

oblique truncation (3.40%), angle-backed (1.70%), divers backed (1.70%), and backed drill (3.40%).

Scrapers form the second most common category, 25.24% of all shaped tools. The highest density of scrapers occurs in Levels III to V. The most common scraper type is the sundry end, marking up 30.77% of all scrapers. Sundry side (15.38%) is the second most common scraper type, followed by convex end (11.54%). Other scrapers include convex end and side (7.70%), concavity (7.70%), sundry combination (7.70%), convergent (3.85%), concave (3.85%), notch (3.85%), sundry end and side (3.85%), convex side (3.85%), and circular (3.85%).

Other shaped tools include points (8.74%), becs (3.88%), burins (2.91%), and *outil écaillé* (1.94%). Among points, the unifacial point is the most common type, representing 77.78% of all points. Other points include the alternate edge (11.11%) and bifacial point (11.11%). Points occur in levels II to IV with the highest density occurring in Level II. Becs occur equally in Levels II to IV and VI. All the burins occur in Level III. The most common type is the angle (66.67%), followed by the dihedral (33.33%) burin.

The heavy-duty toolkit forms 0.17% of the lithic assemblage. The most common tool type is the core scraper (90.90%) followed by the core chopper (9.10%). The heavy-duty tools occur in Levels III to VI. The bifacially modified pieces are rare, consisting only 0.13% of the lithic assemblage. The discoid is the most common type, 87.50% of

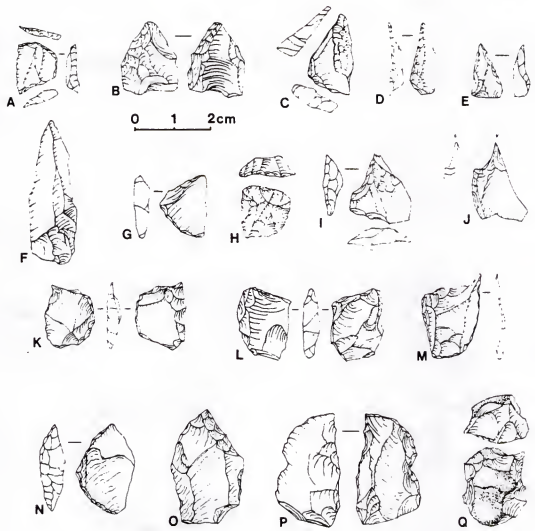


Figure 8-16: Endahakichandi 2b Artifacts: A, trapez; B, hollow-base bifacial point; C and G, triangles; D-E, backed drills; F, flake; H, sundry end scraper; I and M, curve-backed piece; J, angle burin; K and N, crescents; L, bipolar core; O, unifacial point; P, convergent scraper + notch; Q, bec.

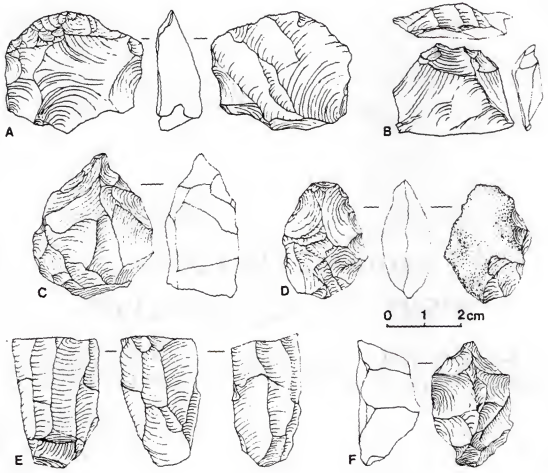


Figure 8-17: Endahakichandi 2b Artifacts: A, convex end scraper; B, convex side scraper; C, bec; D, radial core; E, pyramidal core.

Table 8-7: Endahakichandi 2b Stone Artifacts.

	Levels							
	I	II	III	IV	V	VI	VII	Total
SHAPED TOOLS								
Backed	3	12	13	18	9	2	2	59
Backed fragment		2	5	4	2			13
Scrapers		3	7	8	7	1		26
Scraper fragment		3	4	3	4			14
Outil écaillé	1			1				2
Becs		1	1	1		1		4
Burins			3					3
Points/perciors		3	2	1	3			9
Subtotal								130
BIFACIALLY MODIFIED PIECES								
Discoid		2	4	1				7
Bifacially modified			1					1
Subtotal								8
HEAVY-DUTY								
Core scraper			2	3	3	2		10
Core chopper			1					1
Subtotal								11
CORES								
Bipolar	5	7	3	2	8	5		30
Single platform		1	11		6	4		22
Radial	1		3	1	5	5		15
Part-peripheral		2	1	2	5	2		12
Multiple platform			1	2	1	2		6
Pyramidal		1	1	4	1			7
Opposed double platform		4	12	3	1			20
Disc		1						1
Adjacent double platform		2	2	1				5
Divers single platform	2	1		10				13
Platform/peripheral		4		2				6
Amorphous				2	1	2		5
Subtotal								142
UTILIZED								
Flake	6	4	8	12	13	7	1	51
Angular fragment	1	4	1	4	9	2		21
Blade segment				1	1			2
Subtotal								74
OTHER								
Burin spall	2	1			1			4
Levallois flake			1					1
Blade	3	7	1	4	4			19
Tool spall				1				1
Core fragment	2	3	2	11	8	1		27
Sundry ground item				1				1
Subtotal								53
TOTAL	27	61	82	117	97	37	3	418

all bifacially modified pieces. Bifacially modified pieces occur in Levels II to IV with the highest density occurring in Level III. Blades and utilized blade segments occur in Levels II to V with the highest density occurring in Level II. This category represents 0.33% of the total assemblage. Only one levallois flake found in Level III is represented in the assemblage.

Cores form 2.22% of the lithic assemblage. Cores occur in Levels I to VI with the highest density in Level IV. Twelve core types are represented (Table 8-3). The most common core type is the bipolar form, making up 21.13% of all cores. Bipolar cores occur in Levels I to VI with the highest density in Level V. The second most common type is the single platform (15.50%). Others include opposed double platform (14.08%), radial (10.56%), divers single platform (9.15%), part-peripheral (8.45%), pyramidal (4.93%), etc., (Figure 8-17; Table 8-7). The most common utilized lithic raw material is cloudy quartz (83.89%). Other lithic raw materials include clear quartz (14.31%), quartzite (1.31%), chert (0.44%), obsidian (0.03%), and gneiss (0.02%).

Human burial. Human skeletal remains were exposed in Level V on the southwest corner of the pit. The exposed bones included the skull, clavicle, spinal cord bones, scapular, and arm bones. Like the Qhaḍenaqwete 2 human skeleton, this skeleton was also oriented in a north-south direction. Moreover, the body was placed on its right side facing west. All the exposed bones were in their articulated

positions and in an anatomically "natural" position. On the basis of the closure of sutures, wearing of teeth, and prominent supra orbital ridges we estimated that the skeleton was of a "young" adult (20-30 years old) male individual. Our preliminary observations of the bones found no evidence of pathological lesions or trauma. Although we could not observe a grave shaft in the test pit, the anatomical positions of the bones indicate that the skeletal remains were in primary context.

Ceramics. Pottery remains were sparse: three potsherds were recovered from the excavation. These include two plain body sherds that were recovered from Level II and a neck sherd that was recovered from Level III. The neck sherd is decorated by a single line of incision.

Shell artifacts. A total of 14 beads and one drilled shell fragment were recovered from the excavation. Beads were recovered in Levels II, III, and VI with the highest density occurring in Level III. The most common raw material for beads is ostrich eggshell, 86.66% of the assemblage. Other materials include mussel shell (6.67%) and stone (6.67%).

Bone tools. A bone point or awl was recovered from level III (Figure 8-4). This bone tool was made from a splinter of a long bone and was carefully polished on all sides. It has a fine sharp point that is encrusted with concretions. The concretion on the pointed tip is probably due to post-deposition processes. It measures 40.50 mm long,

5.10 mm wide, and 2.90 mm thick. Some animal bones from Level V may also have been worked.

Other artifacts. Six plastic beads also were recovered from the excavation. These were found in Levels I and II. The highest density occurred in Level I. The occurrence of plastic beads at this shelter also points to its recent utilization by Hadzabe foragers.

Pigments. Seven pieces of dark red (10R 3/6) ochre were recovered in Levels II and III. The highest density (6 pieces) occurred in Level II. The total weight of the pigment pieces is about 7.1 gm. At present the function(s) of the pigments is not clear. However, some of the paintings at this shelter are in various shades of red color (see Chapter 7).

Ecofacts. This shelter yielded a large number of bone remains and teeth, with the highest density occurring in Level IV. The bone remains are composed of both large, medium, and small-sized animals, as well as birds. Some of the bone remains in the upper levels are burned while others are covered with concretions, especially those from the lower levels. A few fragments of snail shell occurred in Levels I and II.

Summary History of Endahakichandi 2b

The occurrence of artifacts all the way down to the bedrock indicates that the deposit at Endahakichandi 2b was built up mainly through use of the shelter as a habitation

location. The occurrence of a sundry ground stone in Level IV suggests a Neolithic period for the upper four levels. The recent occupation of this shelter is indicated in Levels I and II by the occurrence of plastic beads.

On the basis of the occurrence of a human burial on the base of Level V to upper Level VII, the early occupation of this shelter may date to early Holocene if not late Pleistocene. This suggestion is also supported by the occurrence of the art of the "Hunters" (see Chapter 7). Therefore the occupation history of Endahakichandi 2b likely ranges from late Pleistocene/early Holocene times to the present.

Summary

The test excavations revealed a varying sample of lithic artifacts that range from MSA, late Pleistocene LSA, Holocene LSA, and PN to contemporary Hadzabe (e.g., Gordfani 2). Whenever possible, this lithic sample has been compared with that recovered at Mumba by Kohl-Larsen and Mehlman. The excavations also uncovered a small collection of shell beads and mineral pigments. The beads can be associated with personal adornment while the mineral pigments were probably used as the coloring materials for either rock paintings, body decorations or both. The majority of the beads are small, flat, disk beads of ostrich eggshell, bivalve shell, and stone. These beads were locally produced, since beads and fragments in various stages of manufacture were found

along with finished ones. The manufacturing process is discernible from the worked fragments and unfinished beads and involved at least three stages. First, fragments were cut into rough, small rectangles, triangles, squares, and/or irregular pieces. These were then drilled from both sides before further shaping. Lastly, the drilled fragments were polished and shaped into disk-shaped beads.

Traditionally, ceramics are much more sensitive indicators of change than chipped stone tools. However, the sequence of the recovered ceramics is unclear mainly because of the small sample and the undiagnostic nature of the pottery fragments. In spite of this, the decorative motifs on two of the potsherds indicate the presence of PN "Narosura" Ware.

Shaped bone tools and worked bones are few. This may be more a reflection of the few test pits, or it may reflect the general paucity of bone tools in Stone Age "sites" throughout Tanzania. The bone sample is also generally small; perhaps also a reflection of small excavation areas, but possibly, also due to taphonomic biases. It is possible to identify the bone fragments to individual bones as well as to species level of the animal. Many of the bones ranged from fossilized in the lower levels to sub-fossilized in the middle, to non-fossilized in the upper levels (e.g., Gordfani 2). Generally, throughout the sequence, the animal bones are relatively well preserved. The recovered bones were not analyzed and thus the subsistence patterns of prehistoric

people that can be deciphered from the bone remains are not considered in this dissertation. Recent items of Hadzabe material culture, such as beads, food debris, hearths, and tobacco pipe fragments, were recovered throughout the uppermost layers of the sequence.

What then can be said about "change" and/or "continuity" in land-use systems across the excavated cultural sequence given the foregoing discussion? On the most basic level, it is clear that where archeological deposits are deep, a long cultural sequence ranging from MSA to late Pleistocene LSA, Holocene LSA, PN, to modern foragers are represented. The implications of this statement for forager land-use systems during MSA and LSA times will be explored in Chapter 10.

CHAPTER 9
THE TECHNOLOGICAL AND RAW MATERIAL ANALYSIS

Introduction

Since a reasonable typology exists for the Eyasi Basin (Mehlman 1989), my major task in this chapter is to conduct a technological and raw material analysis of the recovered lithic assemblages classified according to Mehlman's typology. Although refitting studies have proved useful in constructing artifact production sequences, to do so is beyond the purpose of this study. The results of the technological and raw material analysis will be used in Chapter 10 to draw inferences about MSA and LSA adaptive behaviors in the Eyasi Basin.

Background

Studies dealing with the organization of lithic technology have been a major aspect of palaeolithic archaeology for a long time. The approach to lithic technological analysis, however, has gained increasing popularity in archaeology, particularly in the last three decades. This trend coincides with the general abandonment of a strictly normative-empiricist view of cultural behavior

in favor of one that emphasizes process (Binford 1965; Clark 1993).

In this kind of lithic study, archaeologists examine the processes underlying virtually all aspects of the organization of lithic technology. The major goals are to understand the links between lithic technology and culture, time, and the landscape's factors (e.g., economic, ecological, and geological) (Bison 1990; Nelson 1991; Ricklis and Cox 1993). Accordingly, technological or production analysis thus attempts to decipher a more balanced view of prehistoric adaptive behaviors from stone artifacts. The focus, in particular, is on patterns of design and core reductions (Andrevsky 1994; Kuhn 1994, 1995; Torrence 1989); raw material availability, acquisition, and selection (Bamforth 1990, 1991; Kuhn 1995); tool use and maintenance (Bamforth 1986, 1990; Binford 1977, 1980; Kelly 1988; Shott 1989, 1994); discard patterns of tools (Binford 1977; Gramly 1980); portability of the resulting toolkits (Keeley 1982; Shott 1986); and post-depositional alteration of the assemblages (Dibble 1995; Schick 1986, 1987).

As the cited references indicate, the theme of lithic technological analysis has received more attention in the New World and European prehistory than in African archaeology. In fact, such analysis has not been undertaken seriously for the MSA and LSA in East Africa. Perhaps this reflects a reluctance by East African archaeologists to move away from

culture-historical studies toward processual studies of human adaptation.

The superiority of a technological approach over a typological one is that the complete range of lithic materials produced can be used in the analysis, not just the shaped tools as in a typological approach. By examining a wide range of the processes underlying artifact manufacture, tool use, maintenance, discard, and portability of the toolkits, it is now possible for archaeologists to explore such issues as hominid planning depth, expressions of conscious choice, anticipation, land-use, and mobility patterns.

In this chapter, I begin such an exploration of the organization of MSA and LSA forager adaptive behaviors at the basic levels of lithic technology and raw material procurement and use. I contend that this analytical approach is an initial <u>but</u> necessary step toward investigating broader issues concerning forager behaviors during the MSA and LSA. An attempt in this chapter will be made, therefore, to generate information on forager behavior as reflected by lithic reduction strategies and raw material procurement and use. A better understanding of these issues is one of the crucial windows required to shed light on MSA and LSA forager behaviors.

Materials and Methods

Because of time constraints, only 3,970 stone artifacts could be analyzed (Table 9-1). This represents 60% of the collected surface and subsurface specimens.

Table 9-1: Counts of Analyzed Lithic Material.

Survey Area	Surface	Excavation
1	151	1,839
2	54	-
3	18	-
4	16	-
5	46	-
6	33	-
7	58	-
10	67	-
11	55	422
12	70	109
13	40	-
14	4	988
TOTAL	612	3,358

Artifact attribute analysis was undertaken at both the University of Dar es Salaam and the University of Florida. Each analyzed artifact was first weighed, using a portable sartorius digital weighing scale. Then, the raw material of the artifact was identified and the macroscopic characteristic of the stone (e.g., lithology, color, inclusions, and natural flaws) and possible sources were noted.

Artifacts were first sorted into six major classes: shaped tools, utilized tools, primary blanks (flakes and blades), cores, non-flaked stones, and angular waste (Appendix I). Each artifact from each of the six categories was typed using Mehlman's typology. The artifact was then

examined to determine its various features or attributes. In some cases this examination depended largely on personal judgment (for qualitative attributes), and in others it was strictly a matter of measurement (quantitative attributes). A simple hand held magnifying glass (at Dar es Salaam) and an electric (Norelco 22 watts) magnifying glass (at Florida) were used to examine the attributes where necessary. As many as twenty or more pieces of information were recorded for a single artifact.

Dimensions were measured to the nearest millimeter. Flakes and blades, as well as tools made of them, were always measured with the striking platform oriented along the base line. Shaped tools lacking a striking platform were oriented with the working edge away from the observer. The lengths of cores were taken from the main platform and along the axis of flaking. Core breadth was measured at right angles to the length, and thickness was taken transversely to width. All the standard metric measurements were taken by using non-digital superpolyamid caliper.

The platform inclination angle was measured at the intersection between the platform remnant plane and the axis of flaking. The angles of retouch or backing were measured at the center of the retouched or backed edge. The platform inclination angles for cores were measured on a major platform (*i.e.*, the one from which most scars originate). The angles were measured by using goniometer. All the measured angles were recorded as average angles.

All the information for each artifact was recorded on coding sheets. Later the coded attribute information was entered into a Macintosh IIx computer for storage, using a PANORAMA database program. The data were not entered directly into the computer as the artifacts were examined since the coding sheet provided an opportunity for recording additional information not included in the computer program's attribute analysis sheet.

Analysis and Results

The entered attribute information was then analyzed on a Macintosh Quadra 800 computer, using a SPSS 6.1 statistical program. Descriptive statistics are used to manipulate attribute information and measurements to produce frequencies, means, and standard deviations.

The surface and sub-surface assemblages from different Survey Areas are treated in this analysis as a single assemblage. This was done to simplify the analysis in order to investigate the organization of lithic technology and land-use systems in the Eyasi Basin across all the cultural stages. Where necessary, typological information will be used to clarify the restrictions that can be imposed by differences in the temporal spans of the analyzed assemblage.

In the following sections, I present the results of the analysis. Where possible, results are presented in terms of graphs for further clarification.

Lithic Raw Materials

Archaeologists recognize that the natural distribution, quality, and durability of lithic resources might have influenced prehistoric knappers to adopt different technological strategies. These technological strategies might have included the creation of "curational" or "expedient" tools (Bamforth 1986; Binford 1977; Kuhn 1989, 1992; Nelson 1991), creation of multifunctional tools (Bleed 1986; Kelly 1988), tool rejuvenation or maintenance (Barton 1990), choices of core reduction techniques (Dickson 1977), and differential economic utilization of raw material (Montet-White and Holen 1991). An understanding of the lithic types used by the Eyasi Basin knappers, their availability, and quality is, therefore, fundamental for this study.

The analyzed lithic assemblage is composed of ten different types of lithic raw materials. These include clear quartz, cloudy quartz, quartzite, obsidian, basalt, chert, phonolite, granite, gneiss, and nephellinite (Figure 9-1). Both locally occurring, and imported materials were recovered as discussed below. Quartz is the most commonly used raw material and is discussed at length after a brief examination of the other materials.

Chert. This stone fractures conchoidally and ranges in color from brownish to chalky-white, depending on the color of the solid matrix where it is found. Chert is locally

available; it is sparse and occurs in small nodules. Eyasi Basin chert is of poor quality compared to that found at Olduvai Gorge, Laetoli, and the Natron Basin. Its surface texture ranges from fine to coarse grained and it is sometimes characterized by internal flaws and voids. Chert constitutes 3.80% of the analyzed lithic assemblages. Although chert fractures conchoidally, its scarce occurrence in the assemblages suggests that it was probably not highly sought after for tool-making.

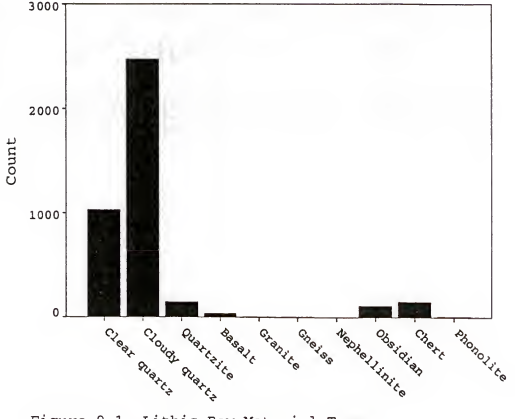


Figure 9-1: Lithic Raw Material Types.

Basalt. This is a volcanic rock that fractures with a somewhat uneven conchoidal fracture. Basalt is readily obtainable in natural outcrops scattered throughout the

Oldeani Volcanic Mountain slopes. It also occurs as water-worn pebbles, cobbles, and boulders in streams that drain the northern section of the Eyasi Basin. Stone artifacts made of basalt occurred only in this northern section of the Eyasi Basin as surface finds at Survey Areas 1, 3, and 4. At these Survey Areas, all the olivine basalt artifacts were characteristically large. On the basis of technology (e.g., flakes with faceted platforms and radial and/or convergent dorsal scar patterns) and typology (e.g., diminutive handaxes, core scrapers, etc.), many of the basalt artifacts recovered from the surface belong to the "Njarasan" Industry and MSA. This suggests that basalt was probably selected for the manufacture of large, heavy-duty cutting and scraping tools. From the four test excavated shelters, basalt was recovered only at Gordfani 2. At this shelter, basalt occurred mainly in the MSA (IX-XII) levels. Basalt comprises 0.90% of the analyzed lithic assemblages, despite its local and abundant availability (Figure 9-1).

Obsidian. This is a glassy volcanic rock. Obsidian has a fine grained texture and flakes with a conchoidal fracture. In the Eyasi Basin, and northern Tanzania in general, obsidian is a non-local or "exotic" lithic raw material. The source for the northern Tanzania obsidian has been traced to the central Rift Valley in Kenya, about 200 km north of the Eyasi Basin (Merrick and Brown 1984). Obsidian constitutes 2.80% of the lithic assemblage.

Phonolite. This rock is fine-grained lava, usually green. Phonolite is readily obtainable in natural outcrops scattered throughout the Sadiman Volcanic Mountain slopes. It also occurs as water-worn pebbles, cobbles, and boulders in streams which drain the northern section of the Eyasi Basin. The lithology is described by Hay as "clasts are chiefly porphyritic nephelinite and nepheline phonolite, dark greenish-gray" (1976, p. 13). Although phonolite is a fine-grained material, the flaking of it is affected by internal flaws that gives the stone a grain. Flaking must, therefore, be directed either with or directly across this grain to ensure the best results (Jones 1994). Artifacts made of green phonolite material were recovered from the surface of Survey Area 4 and from test excavations at Gordfani 1 (Level VIII) and Gordfani 2 (MSA Levels XII and XIII). Green phonolite forms only 0.20% of the lithic assemblages (Figure 9-1).

Quartzite. Quartzite constitutes 3.80% of the lithic assemblage. Quartzite is usually found as river pebbles, massive *in situ* boulders, or small chunks and exfoliated slabs. Eyasi Basin quartzite is coarse to fine-grained and more often micaceous. Quartzite pebbles were suitable for hammerstones.

Quartz. This rock is abundant and very widespread in the Eyasi Basin; it forms 88.30% of the analyzed lithic assemblage. It occurs as veins in ridges and hilltops, naturally eroding scatters in the soil, and pebbles in river

and stream beds. Quartz is a hard rock (7 on Moh's scale), which, when fractured, produces sharp cutting-edges that need no more secondary modification. On the basis of crystalline structure, color, and texture, two types are distinguished in the lithic assemblage: clear quartz and cloudy or milky quartz.

Clear quartz is colorless, transparent to translucent rock crystal. It has a fine grained texture and, when without internal flaws, it fractures conchoidally. In the Eyasi Basin, clear quartz is infrequent and rarely exceeds 5 cm in length. It occurs as pegmatite, small nodules in gneiss or granite rocks. Clear quartz comprises 26% of the lithic assemblage and 29.46% of all quartz artifacts.

Cloudy quartz is the most commonly utilized raw material, constituting 62.30% of the analyzed lithic assemblages and 70.54% of all quartz artifacts. Cloudy quartz is nearly opaque and milky-white in appearance. The surface texture ranges from coarse grained to sugary, and it fractures un-evenly. In the Eyasi Basin, the natural size of cloudy quartz ranges from small pebbles to large cobbles and boulders. It is often characterized by internal flaws that can cause the flaked piece to break. Once flaws were detected, knappers often stopped further modification in order to avoid breakage. Consequently, MSA and LSA foragers in the Eyasi Basin were faced with the problem of judging the internal quality of quartz raw materials.

Other stones. Occasionally granite, gneiss, quartzite, and nephellinite were also used as raw material for stone artifacts. Granite constitutes 0.10%, gneiss 0.10%, and nephellinite 0.10% of the assemblage. Granite was suitable for grinding materials and gneiss for anvils as it "lacks the mechanical attributes making it useful for any *other* type of artifacts" (Hay 1976, p. 184 emphasize is mine). All these materials are locally available and granite and gneiss are abundant.

Lithic Raw Material Procurement and Use

Two modes of lithic raw material procurement behavior can be inferred from the lithic raw material data: localized and non-localized patterns of lithic resource procurement and use. A localized procurement and use behavior of lithic resources is evident as 97.20% of the analyzed lithic assemblage is of local materials. Since local lithic resources are abundant and equally distributed throughout the Eyasi Basin, local lithic raw materials might have been utilized on an encounter, immediate-need basis. Accordingly, procurement and uses of lithic resources might have often been concurrent with the land-use systems inherent in the subsistence patterns.

A non-localized procurement and use behavior is indicated by 2.80% of obsidian that is an "exotic" lithic raw material in the Eyasi Basin. Although increasing procurements of "exotic" and high-quality raw materials have

been noted in many regions of Europe during the UP (Gamble 1986; Kozlowski 1991), in the Eyasi Basin there was no significant increase in the procurement and uses of either obsidian or chert during the LSA and PN. It seems that prehistoric people of different cultural stages maintained essentially constant access to the abundant, local raw material sources in the Basin.

Intensity of Lithic Raw Material Utilization

When recovered, the forms of cores are determined by a number of factors, including: 1) technological aspect; 2) initial size and shape of raw material; 3) type, quality, and availability of raw material; and 4) prehistoric decisions concerning when the core should be abandoned. Given that quartz is the dominant lithic resource in the Eyasi Basin and is very widespread, characterized by internal flaws, and difficult to work, one would assume an extravagant (or, less than frugal) behavior toward quartz raw material utilization. This behavior would be reflected by cores being readily discarded after minimal and discontinuous flaking, and by cores with a high percentage of cortex.

In the following analysis, I will examine the utilization of lithic raw materials in the Eyasi Basin in terms of the degree of core abandonment, core surface utilization, and percentage of cortex present.

Three lines of evidence give rather strong indications to refute the proposition that prehistoric foragers in the

Eyasi Basin had an extravagant behavior toward lithic raw materials. Instead, the evidence supports an alternative case in which lithic technology in the Eyasi Basin was characterized by intensive utilization of raw material with relatively little waste. This suggestion gains support from the analysis of the different stages of core abandonment. A descriptive statistic (frequency) of the intensity of core utilization was performed for 677 cores. As shown in Figure 9-2, about 21% of all cores were discarded in stage I of the flaking process, *i.e.*, cores were minimally flaked.

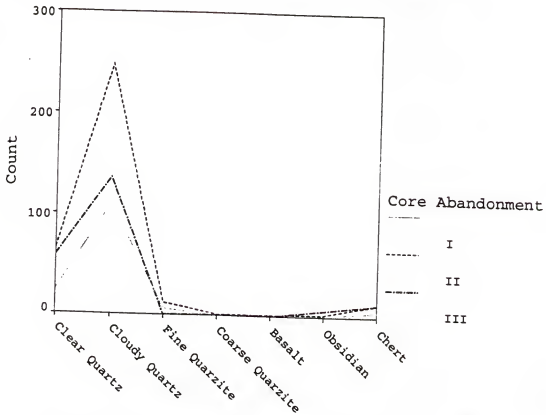


Figure 9-2: Stages of Core Abandonment.

Furthermore, 49% of all the cores were abandoned in stage II of the flaking process, *i.e.*, they were considerably flaked. Flaking of about 30% of all the cores was abandoned

in stage III of the flaking process, *i.e.*, cores were exhausted so that they could not be flaked any further.

The indication that lithic technology in the Eyasi Basin was characterized by intensive utilization of raw material with relatively little waste appears to gain further support from the percentage of flaked core surface. The percentage of the core surface utilized exhibits very systematic behavior. A descriptive statistic (frequency) of the percentage of the core surface flaked was conducted on 677 cores. Sixty-four percent of all cores had greater than 75% of their edge surface continuously spalled. Only 3.12% of all the analyzed cores had their surfaces discontinuously spalled. All the results indicate intensive utilization of raw materials.

Intensive utilization of raw material with little extravagant use is also supported by the amount of cortex found on cores. I assumed that intensively utilized cores would either lack cortex entirely or exhibit a small percentage of cortex. About 677 cores were analyzed for the percentage of cortex present. Thirty percent of the analyzed cores were non-cortical. Many of the non-cortical cores were abandoned in stage III (Figure 9-3). Also, it can be seen in Figure 9-3 that more than 75% of the cores have < 50% cortex.

The analysis of the inferences of initial shape of core materials indicates that the initial shape of cores may influence when the flaked core should be abandoned. As shown in Figure 9-4, the number of tabular cores decreases

dramatically from stage II to stage III of core abandonment, while those of initial rounded shapes (e.g., stream pebbles) increase in stage III. This indicates that the initial shape of lithic raw material had an important influence in the decision of when cores should be abandoned.

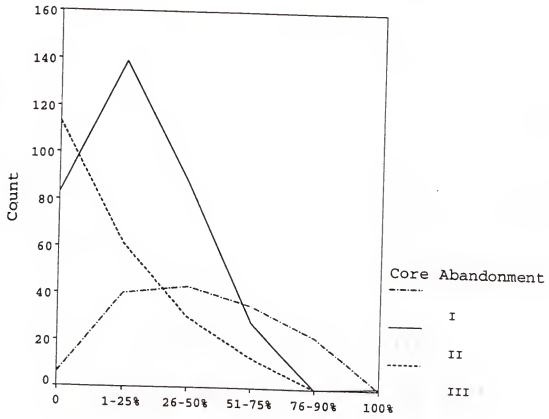


Figure 9-3: Core Cortex by Stages of Core Abandonment.

In terms of raw material type and quality, it is doubtful if these factors had significant influences in determining when flaked cores should be abandoned. As shown in Figure 9-2, high quality lithic raw materials that flake with a conchoidal fracture (e.g., obsidian, chert, clear quartz, etc.,) were also abandoned in stage I of the flaking process. In addition, the results of the analysis of

internal quality (presence or absence of internal flaws) of cores indicate that about 33% of the 212 cores with internal flaws were abandoned in stage I, 52% were abandoned in stage II, and 15% were abandoned in stage III. The occurrence of considerably flaked and exhausted cores with internal flaws either indicates a frugal behavior toward raw material or an advance in technological aspects that controlled the problems associated with internal flaws.

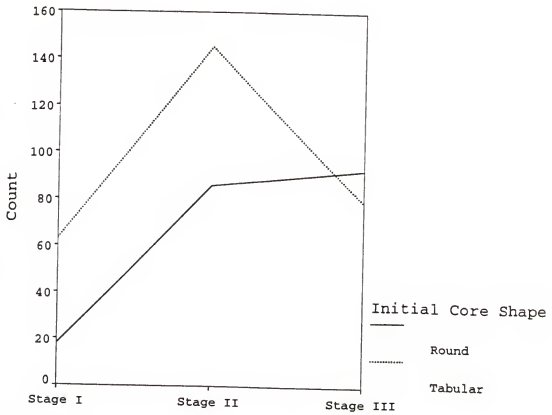


Figure 9-4: Core Abandonment by Initial Core Shape.

In summary, the results of the analysis strongly indicate non-wasteful behavior toward raw material utilization in the Eyasi Basin. This frugal attitude is indicated by the great majority of considerably exploited and

exhausted cores. Therefore, to suggest an intensive degree of raw material utilization in the Eyasi Basin seems justified. Since lithic raw material size, shape, type, and quality have been shown in the analysis to have no major influence on lithic raw material utilizations, the only other factors that would have influenced the intensive utilization of raw material in the Eyasi Basin are technological and behavioral aspects (e.g., decisions by knappers regarding when cores should be abandoned).

Flakes and Utilized Flakes

Flakes. The analyzed assemblage is composed of 926 flakes, forming about 23% of the assemblage. The majority of flakes are end-struck and bear no cortical surfaces. About 97% of the flakes have fresh, sharp edges, and 89% lack any evidence of patination.

The mean length for flakes is 23.86 mm (sd. 11.60), mean breadth is 16 mm (sd. 9.42), and mean thickness is 6.46 mm (sd. 3.85). The mean platform inclination angle is 92° (sd. 6.59). The majority of the flakes have restricted platforms *i.e.*, their platform length is less than half the flake breadth (Figure 9-5). This indicates that the points of percussion were well within the core platforms. Flakes with broad platforms (*i.e.*, platform length is greater than half the flake breadth) indicate that the points of percussion were even further within the core platforms.

Flakes with no clear dorsal scars were classified as undetermined. The majority of flakes with dorsal scars have unidirectional parallel, convergent, and irregular dorsal scars (Figure 9-6). These indicate a single platform core reduction strategy. Few flakes have bi-directional opposed and irregular dorsal scars (Figure 9-7). This indicates the use of two or more platforms during reduction. The presence of flakes with multi-directional dorsal scars suggests turning of the core and change of the direction of flaking during knapping. Radial dorsal scars indicate a peripheral core reduction strategy.

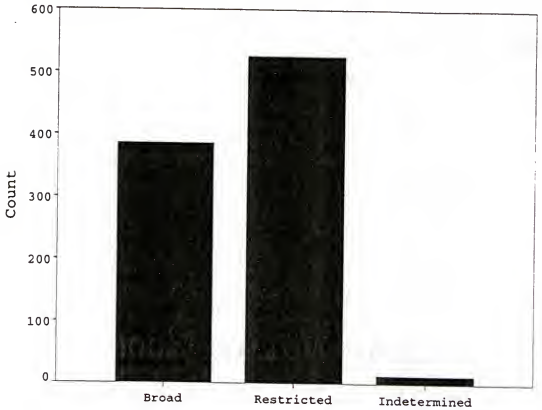


Figure 9-5: Flake Platform Size.

Most flakes have plain platforms (Figure 9-7). This suggests a pattern of removing flakes by using as striking

platforms the formally removed scar surfaces. This reduction strategy is more complex. When it is systematically applied using both faces and edges of the core, it will usually result in symmetric and more perfect geometric cores and tools, such as radial and disc cores, bifaces and chopping tools. When it is used in an unsystematic fashion using one or two platforms, it will usually result in single and double platform cores.

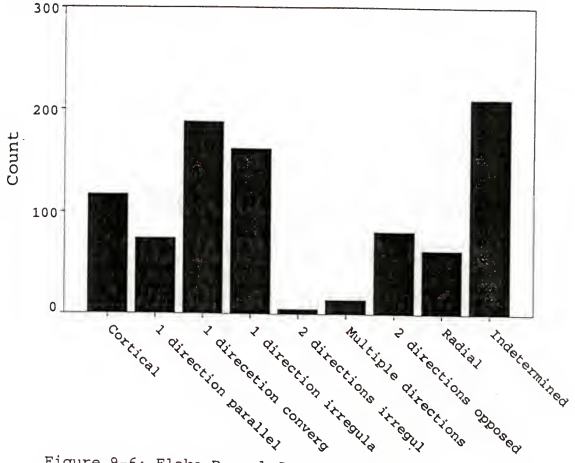


Figure 9-6: Flake Dorsal Scar Patterns.

Dihedral and pointed platforms are few (Figure 9-7). The presence of dihedral and pointed platforms suggests either maintenance/rejuvenation of core platforms or a bifacial reduction strategy. Although faceted and abraded

platforms are few (Figure 9-7), their occurrence suggest preparation of core platforms for flake removal. Core platform preparation is also indicated by the occurrence of flakes with step fractures on the platform dorsal edge.

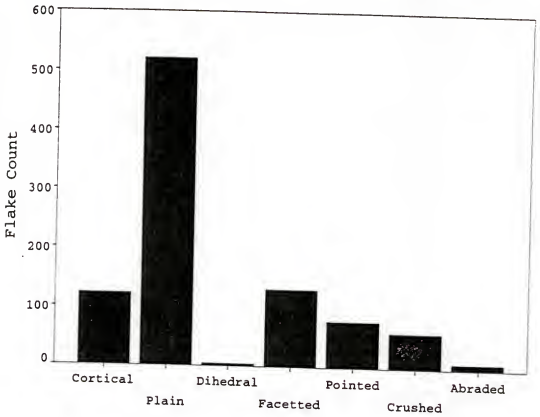


Figure 9-7: Platform Surface Preparation.

Platform preparation is complex lithic technology. The rate of intensely prepared platforms, as reflected by flakes is, however, low, suggesting that elaborate core preparation for flake removal was not very much favored by the Eyasi Basin knappers. The uncertainty of the outcome, because of the inconsistent quality of quartz, might have discouraged knappers from preparing core platforms. Cortical platforms indicate some flakes were removed without prior modification of the cobble. This is because in quartz, the cortical

surface of the cobbles provides a suitable platform for flake removal. Flakes with crushed platforms indicate either excessive force of impact of the hammer on the core platform or the use of hard hammers. Pointed platforms indicate the use of either a punch technique or a soft hammer.

Many of the flakes are ovate or elliptic in form. The majority of flakes display diffuse bulbs and few have pronounced or large bulbs. Flakes with undefined but not crushed bulbs were classified as flakes with absent bulbs. Thus, diffuse bulbs indicate the use of soft hammers while pronounced, absent, and crushed bulbs indicate the use of hard hammers. The occurrences of flakes with thinned bulbs indicate the existence or knowledge of hafting technology. Overall, many of the flakes are of hard hammer mode. In spite of quartz being a tough lithic material characterized by internal flaws, many of the flakes have a feather termination.

Utilized flakes. The analyzed assemblage is composed of 191 utilized flakes. In terms of the analyzed technological information for flakes, the only difference between utilized flakes and un-utilized flakes is that utilized flakes are generally larger. The mean length for utilized flakes is 24.57 mm (sd. 12.92), mean breadth is 18.07 mm (sd. 11.59), and mean thickness is 6.79 mm (sd. 4.45). This suggests a selection of larger blanks for utilization in anticipation of reduction. Although most of the utilized flakes have non-cortical dorsal surfaces, the occurrences of utilized flakes

with 100% cortical dorsal surfaces suggest that primary flakes were also selected for utilization.

Levallois Flakes and Utilized Levallois Flakes

Levallois flakes. Twenty-two levallois flakes occur in the assemblage, forming 0.55% of the lithic assemblage. The mean length for levallois flakes is 36.83 mm (sd. 17.19), mean breadth is 25.71 mm (sd. 15.03), and mean thickness is 9.00 mm (sd. 3.42). The mean angle is about 88°. The majority of the flakes have uni-directional convergent dorsal scar patterns (Figure 9-8). The most common striking platform types are the plain and faceted platforms. Other technological characteristics of levallois flakes are not significantly different from those observed for other flakes.

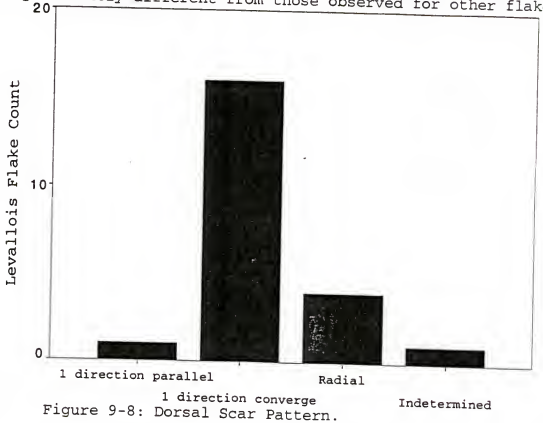


Figure 9-8: Dorsal Scar Pattern.

Utilized levallois flakes. Only five utilized levallois flakes occur in the analyzed assemblage. There are no significant differences between utilized levallois and non-utilized Levallois flakes. The only difference is in blank dimension. The mean length for utilized levallois flakes is 26.58 mm (sd. 15.11), mean breadth is 24.50 mm(sd. 5.75), and mean thickness is 9.42 mm (sd. 3.46).

Blades and Utilized Blades

Blades. Only fifty-nine blades occur in the analyzed sample. The mean length for blades is 23 mm (sd. 7.76), mean breadth is 8.64 mm (sd. 3.20), and mean thickness is 4.03 mm (sd. 1.75). The mean platform angle for blades is about 90°. In terms of the analyzed technological characteristics for flakes, the only significant difference between flakes and blades is that all the blades have uni-directional dorsal scar patterns.

Utilized blades. Only five utilized blades were found. The mean length for utilized blades is 23.96 mm (sd. 6.39), mean breadth is 10.78 mm (sd. 2.40), and mean thickness is 3.82 mm (sd. 1.50). This appears to support further the suggestion that relatively large blanks were selected for utilization in anticipation of decreasing size during use. The mean platform angle for utilized flakes is 90°. Other technological features of utilized flakes are similar to those of un-utilized blades.

Overall, blades and utilized blades form only 1.61% of the analyzed lithic assemblage. The preponderance of flake scars (non-parallel dorsal scar patterns) over blade scars (parallel dorsal scar patterns) is clear cut. Blade dorsal scars form an insignificant proportion. There does not seem to exist a specialized effort for the production of blades. Generally, it is tenable at this stage to regard the Eyasi Basin lithic assemblage as typifying a flake technology.

Shaped Tools

There are 510 shaped tools, forming 12.85% of the analyzed assemblage. About seven tool categories are represented. These include scrapers, backed tools, points, burins, becs, composite tools, and *outil écaillés*.

Scraper tools. There are 201 scrapers, comprising 39.2% of all shaped tools. Most of the scrapers are on flake blanks, indicating a high standardization in blank type selection. Yet, few scrapers are on split cobbles and chunks. This suggests that some scrapers were made on the spot to fulfill immediate needs.

The mean length for scrapers is 27.51 mm (sd. 12.71), mean breadth is 20.63 mm (sd. 9.97), and mean thickness is 8.43 mm (sd. 4.30). About 52% of the scrapers are on microlithic blanks, measuring between 5.70 mm and 24.80 mm long. The rest (48%) are on larger blanks, measuring between 25.20 mm and 93.70 mm long. Scatter diagrams of scraper length versus scraper breadth and scraper length versus

scraper thickness indicate a positive correlation for scraper length and scraper breadth on one hand, and scraper length and scraper thickness on the other (Figure 9-9, 9-10). This further supports the assumption made earlier that larger blanks were selected for making tools in anticipation of reduction.

Although most of the scrapers are made on cloudy quartz, other lithic raw materials are also represented (Figure 9-11). Given the low frequencies of quartzite, basalt, nephellinite, obsidian, chert, and phonolite raw material in the analyzed assemblage, clearly fine grained materials that flake with a conchoidal fracture were more frequently selected for making scraper tools than were coarse grained materials.

In terms of striking platform size, there is no difference between broad and restricted platforms among scrapers, suggesting that platform size was not a significant factor in selecting blanks for scrapers. Yet, when the occurrence of broad platforms among scrapers is compared with their occurrence among flakes, clearly blanks with broad platforms tended to be selected for scrapers.

The majority of the scrapers had dorsal scar patterns that were undetermined. Those with determined dorsal scar patterns had scars which were unidirectional parallel, convergent, and irregular, bi-directional irregular and opposed, radial, and multiple directional. These indicate they were reduced from single platforms, opposed double

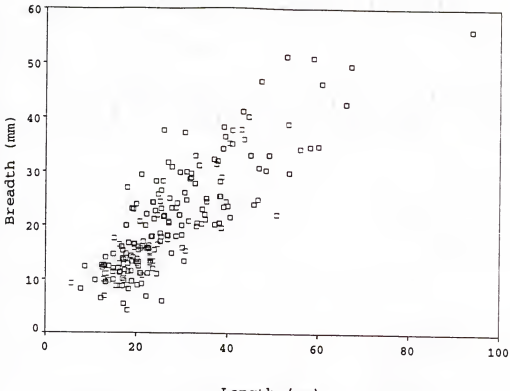


Figure 9-9: Scatter Plot of Scraper Length Versus Breadth.

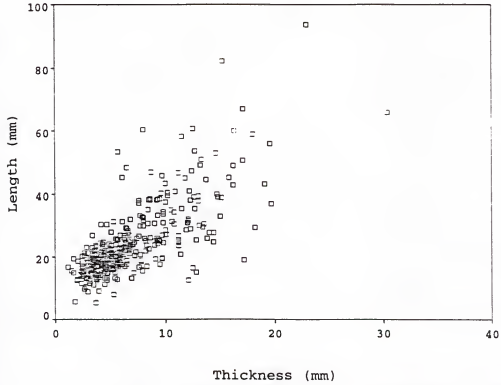


Figure 9-10: Scatter Plot of Scraper Length Versus Thickness.

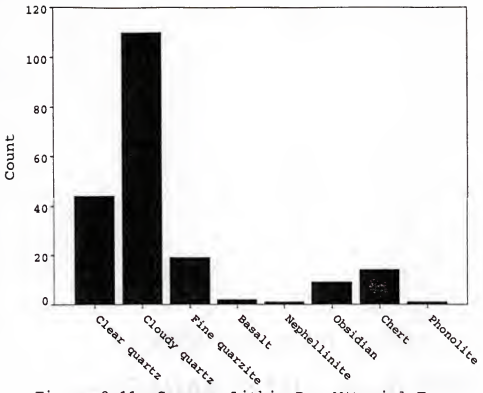


Figure 9-11: Scraper Lithic Raw Material Types

platforms, and pyramidal, levallois, and radial cores. Cortical scrapers indicate that primary flaking blanks were also selected for tool manufacturing. The most common platform types among scrapers are the plain and faceted platforms. Many of the scrapers were ovate or elliptic in plan form.

On the basis of the morphology of the retouched edges, I classify the analyzed scrapers into five major classes or categories. These include convex, concave, circular, straight, and irregular scraping edges. The occurrence of one or both of the latter two classes form Mehlman's (1989) sundry class. These five major classes of scraping edges can occur on the tool edge or edges either singularly or in combination. The locations of the retouch and the morphology of the retouched edge or edges can be used to define

different types of scrapers. Twenty-two types of scrapers have been identified by Mehlman (1989) for the Eyasi Basin. Twenty-one scraper types occur in the analyzed assemblage (Figure 9-12).

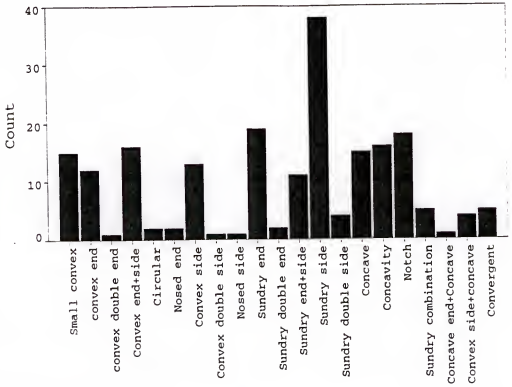


Figure 9-12: Types of Scrapers.

At this stage, it is not the intention of this analysis to determine whether the represented scraper types "represent discrete, desired end products or points along a continuum of reduction that led to changes in the tool's morphology and thus to their assignment as different types" (Dibble 1995, p. 318-319). Nevertheless, it is important to note that the most common type is the sundry side, forming 18.9% of all scrapers (Figure 9-12). If we assume that tools represent discrete, desired end products, then one can argue that

sundry side scrapers were more preferred than any other scraper type. Yet, analysis of the morphology of scraping edges shows no significant preferences as other non-sundry scraping edges are well represented (Figure 9-13).

Analysis of both the position of the retouched edge and the location of retouches shows that the 201 analyzed

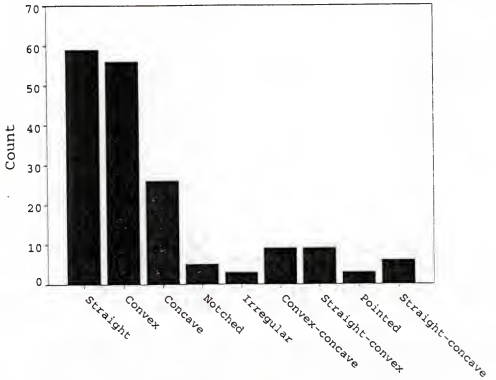


Figure 9-13: Scraper Retouched Edge Morphology.

scrapers have 287 retouched edges. This indicates that some scrapers have multiple retouched edges. About 42% of the analyzed retouched edges were located on the distal edges of the scrapers. The mean angle of retouches for the distal scraping edge is 61° (sd. 11°). The minimum angle is 34°, maximum angle is 86°, and the mode is 60°. About 4% of the analyzed retouched edges are located on the proximal edge of the scrapers. The mean angle of retouches for the proximal

scraping edge is 65° (sd. 11). The minimum, maximum, and mode angles are 55°, 86°, and 56°, respectively. Twenty-five percent of the retouched edges were located on the right lateral edges of the scrapers. The mean angle of retouches is 61° (sd. 12.26). About 29% of the retouched edges were located on the left lateral edges of the scrapers. The mean angle of retouches for the left lateral edge is 63°. As the distribution of the angle of retouches indicates, the majority of the scrapers have middle angles of edge retouch, between 45° and 70°. Yet, very steep retouch angles of > 80° occur, indicating core or cobble edges. The length and thickness of the retouched edges were not measured during attribute analysis, but, I would hypothesize that the angles of retouch (whether steep or not) largely depend on the length and thickness of the retouched edge.

Most of the retouches on the scrapers are unifacial-obverse and unifacial-inverse (Table 9-2). Bifacial and part-bifacial retouches are rare. This indicates a preference in retouching only one side of the scraping edge. In this case, preference was probably due to functional reasons rather than to cultural ones. Many of the scrapers had simple retouch and a few had stepped retouch (Figure 9-14). Most of the retouches were of shallow scars, indicative of a hard hammerstone. The most common retouch intensity is the marginal to semi-invasive retouch, *i.e.*, retouch breadth of 2 mm to 3 mm on the edge (Figure 9-15). The second most common is the light or marginal (< 2 mm wide) retouch. Semi-

invasive (3-4 mm wide) and invasive (> 4 mm wide) also occur (Figure 9-15).

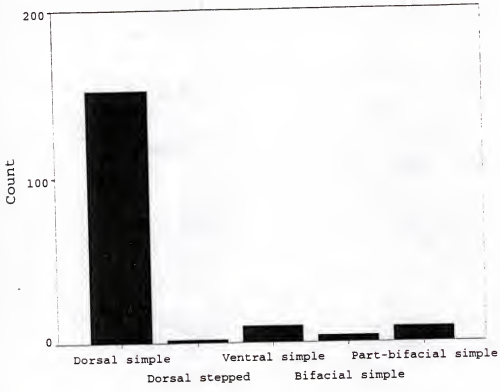


Figure 9-14: Scraper Retouch Type.

I conducted two correlation analyses between the invasiveness of retouches and the size (breadth) of scrapers, and the angle of retouches and size (breath) of scrapers. I assumed that the edges of broad scrapers will always have semi-invasive to invasive retouches, and broad scrapers will always have semi-steep (>60°) to steep (>80°) angles of retouch. The results of the analysis show correlation neither between invasiveness of retouch and size (breadth) of scraper nor between retouch angles and scraper size. The results indicate that while larger primary blanks might have

been selected by the Eyasi Basin knappers for making tools, the size of the blanks had no effect on the result of the manufactured tools. Furthermore, since most of the scraper edges have light to semi-invasive retouches, the reduction continuum model (varying degrees of edge resharpening and rejuvenation) as the explanation for the end products of the tools we analyze (Barton 1990; Dibble 1995, 1987) is untenable for the Eyasi Basin scrapers. I would suggest that the needs of the Eyasi Basin prehistoric knappers might have influenced the end product of the manufactured tools.

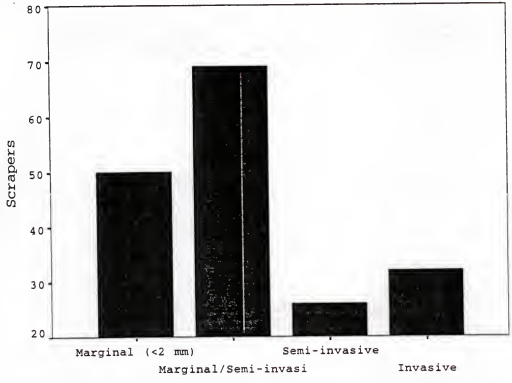


Figure 9-15: Invasiveness of Retouch.

Table 9-2: Scraper Retouch Direction and Location.

Retouch Direction and Location	N	% Total
Obverse, left lateral edge	38	21.5
Obverse, right lateral edge	31	15.4
Obverse, both lateral edges	5	2.5
Obverse, distal edge	40	19.9
Obverse, distal and left lateral edges	6	3.0
Obverse, distal and both lateral edges	12	6.0
Obverse, proximal and both lateral edges	1	0.5
Obverse, proximal and distal edges	2	1.0
Obverse, semi-circular edge	1	0.5
Obverse, circular edge	2	1.0
Inverse, left lateral edge	4	2.0
Inverse, right lateral edge	3	1.5
Inverse, distal edge	6	3.0
Inverse, distal and left lateral edges	1	0.5
Inverse, distal and right lateral edges	1	0.5
Bifacial, left lateral edge	2	1.0
Bifacial, distal edge	2	1.0
Part-bifacial, left lateral edge	1	0.5
Part-bifacial, both lateral edges	1	0.5
Part-bifacial, distal edge	1	0.5
Part-bifacial, distal and left lateral edges	2	1.0
Part-bifacial, distal and both lateral edges	2	1.0
Obverse, left + inverse right lateral edges	2	1.0
Obverse, right + inverse left lateral edges	2	1.0
Obverse, both lateral + inverse proximal edges	1	0.5
TOTAL	177	100.0

Backed tools. There are 149 backed pieces, forming 29.2% of all shaped tools. Only two types of primary blanks were used for backed tools, flake and bladelete. The most common type is the flake. Contrary to the scrapers where unstandardized blanks such as cobbles and chunks were also selected for tool manufacture, only chipped flakes and bladeletes were selected for backed tools. This indicates a high standardization in blank selection for backed pieces.

The mean length for backed tools is 27.51 mm (sd. 12.71), mean breadth is 20.63 mm (sd. 9.97), and mean

thickness is 8.43 mm (sd. 4.30). About 82% of the backed tools are on microlithic blanks, measuring between 5.40 mm and 24.80 mm long. The rest (18%) are on larger blanks, measuring between 25.10 mm and 82.20 mm long. A scatter diagram of the dimensions of backed pieces shows that the backed blanks approach a one-to-one length/breadth ratio.

The majority of the backed tools are made of clear quartz (Figure 9-16). Given that cloudy quartz is the dominant lithic raw material in the Eyasi Basin, it is evident that fine grained materials that flake with a conchoidal fracture were more often selected for making backed tools.

About 97.3% of the backed tools have fresh and sharp edges, 2% are slightly abraded, and 0.7% are heavily abraded. Many of the backed tools have plain platforms . Backed and retouched platforms were probably the results of secondary edge modification rather than preparations of core platforms. Very few backed tools have cortical platforms indicating that primary flakes and bladeletes were less often selected for backed tool manufacture. This explanation is further supported by the analysis of the percentage of cortex present as the majority of the backed tools have no cortex . This shows that non-cortical blanks were more preferred for backing tools.

The majority of the backed tools had dorsal scar patterns that were undetermined. Those with determined

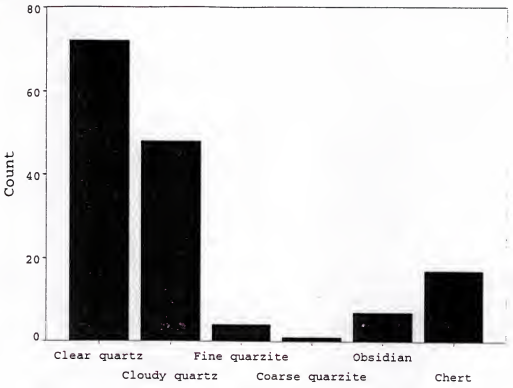


Figure 9-16: Raw Material Types for Backed Tools.

dorsal scar patterns had uni-directional parallel, convergent, and irregular dorsal scars, bi-directional irregular and opposed scars, radial scars, and multiple directional scars. This indicates that blanks for backed tools were selected from blanks that resulted from different reduction strategies and not necessarily from blade technology. In fact, the blanks on which backed tools are made have little bearing on the core reduction strategy; they merely tend to reflect any reduction strategy available at the moment.

Ten types of backed tools have been identified by Mehlman (1989) for the Eyasi Basin. Nine of the backed tool types occur in the analyzed assemblage (Figure 9-17). The most common types are the curve-backed (32.9%), straight-

backed (22.8%), and crescent (20.8%). Other types of backed tool are rare.

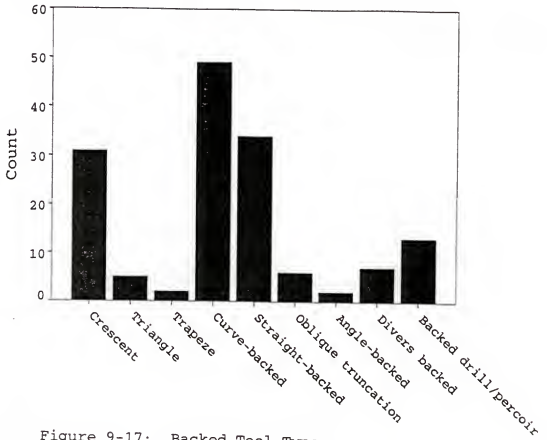


Figure 9-17: Backed Tool Types.

The analysis of the morphology of backed edges shows that many of the backed tools are either curve-backed on the distal and proximal ends or straight-backed on the lateral edges. Backed edges with a combination of backing edge shapes (e.g., curved-straight) are rare. Mostly, the type of backing is feather and the direction of backing is obverse. Most of the backing covers the whole backed edges. The mean angle of backing for the backed tools is 81° (sd. 11.44). The mean thickness of the backed edges is 3.26 mm (sd. 1.52).

Points. There are 77 points, forming 15% of all shaped tools. Many of the points are on end-struck flakes (65%) and

a few are on side-struck flakes (2.6%), blades (1.3%), Levallois flake (10.4%), and core/chunks (13%). About 5.2% of the primary blanks were undetermined. The mean length for points is 26.42 mm (sd. 8.43), mean breadth is 19.81 mm (sd. 8.61), and mean thickness is 7.29 mm (sd. 2.90). Again, the dimensions of points are larger when compared with un-utilized flakes, supporting the assumption that larger primary blanks were selected for making tools in anticipation of reduction. Unlike backed tools, the majority of the points are made of cloudy quartz (Figure 9-18). Points made of high quality raw materials are rare. About 92.2% of the points have fresh and sharp edges, 6.5% have slightly abraded edges, and 1.3% are moderately abraded. Although plain platforms dominate among points, faceted platforms are also well represented. Regarding striking platform size, there is no significant difference between broad and restricted platforms among points, suggesting that platform size was not a limiting factor in selecting primary blanks for points.

Although the patterns of dorsal scars could not be determined for the majority of the points (because of the nature of cloudy quartz), uni-directional convergent and radial dorsal scar patterns are the majority among points that exhibit dorsal scars. This indicates that primary blanks that result from bifacial reduction strategies were more favored for points. Points with cortical dorsal surfaces are very rare.

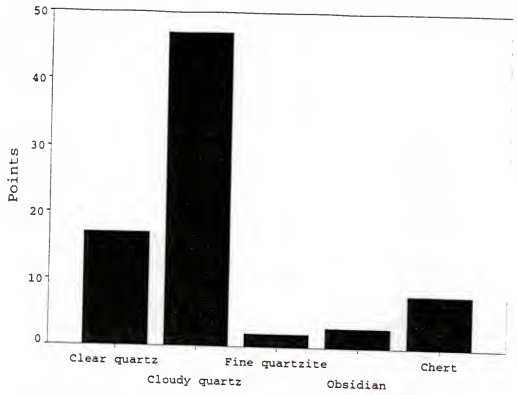


Figure 9-18: Raw Material Types for Points.

All three types of points identified by Mehlman (1989) occur in the analyzed assemblage. The most common type is the unifacial point, forming 83.1% of all points (Figure 9-19). The other types are the alternate edge (5.2%) and bifacial (11.7%) points.

The majority of the points have obverse retouch on the distal end of the points. The mean angle of retouches for the distal edge is 53° (sd. 10.45°). The minimum angle is 32° and the maximum angle is 86°. Only two of the analyzed points have retouch on the proximal edges. The mean angle of retouches for the proximal edge is 57° (sd. 15.56°). The minimum angle is 46° and the maximum angle is 68°. The mean angle of retouches for the left lateral edge is 61° (sd. 8.22). The minimum angle of retouch is 8° and the maximum angle is 76°. The mean angle of retouches for the right

lateral edge is 62°. The minimum angle of retouches is 9° and the maximum angle is 78°. The majority of the points have middle angles of between 45° and 70°. Yet, very steep or high angles of > 80° are absent.

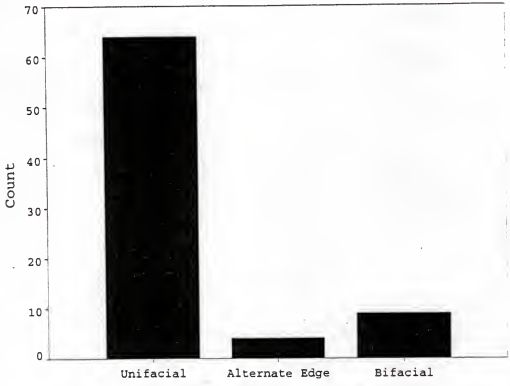


Figure 9-19: Point Types.

Many of the points have simple retouch. Stepped retouch is very rare. The retouches were of shallow scars, indicative of hard hammerstones. Marginal to semi-invasive scars are the dominant retouch among points. Nevertheless, light or marginal retouch is also well represented. Correlation analysis between the invasiveness of retouches and size (breadth) of points shows no relationship.

The most common lateral edge shape for the points is the convex, followed by straight edge shape. Consequently, many of the points are semi-triangular to ovate in form with

pointed bits and straight butts. The mean breadth of points measured at one-fourth distance below the bits is 18.75 mm, mean breadth measured at one-half distance below the bits is 18.14 mm, and mean breadth measured at three-quarter distance below the bits is 11.16 mm.

Table 9-3: Point Retouch Direction and Location.

Retouch Direction and Location	N	% Total
Obverse, left lateral edge	4	5.2
Obverse, right lateral edge	3	3.9
Obverse, both lateral edges	1	1.3
Obverse, distal edge	26	33.8
Obverse, distal and left lateral edges	6	7.8
Obverse, distal and right lateral edges	3	3.9
Obverse, distal and both lateral edges	5	6.5
Obverse, circular edge	1	1.3
Inverse, left lateral edge	1	1.3
Inverse, distal edge	5	6.5
Inverse, distal and left lateral edges	1	1.3
Inverse, distal and both lateral edges	1	1.3
Bifacial, left lateral edge	2	2.6
Bifacial, distal edge	2	2.6
Bifacial, distal and both lateral edges	1	1.3
Part-bifacial, distal and both lateral edges	1	1.3
Obverse, left + inverse right lateral edges	1	1.3
Obverse, right lateral + inverse distal edges	1	1.3
TOTAL	77	100.0

Burins. Only thirty-five burins occur, forming 6.9% of all shaped tools. Blanks for burins were mainly flakes, but a small number of bladelets, a chunk, and a core were also used. The mean length for burins is 23.72 mm (sd. 12), mean breadth is 14.81 mm (sd. 8.57), and mean thickness is 5.90 mm (sd. 3.70). Clear quartz is the dominant raw material for burins. Although cloudy quartz is the second most common material, it appears that high quality raw materials were more favored for burins (Figure 9-20).

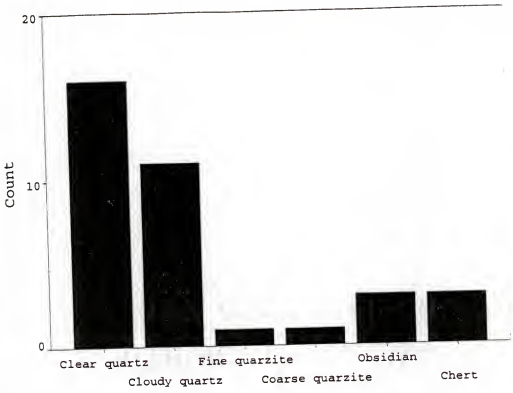


Figure 9-20: Raw Material Types for Burins.

The majority of the burins are angle burins with single blows or burin facets on the burinated edge. Dihedral burins, *i.e.*, burins with two symmetric blows or burin facets also occur. Only three of the twenty-seven angle burins have more than one burin blow or facet on their burinated edges. Two of the five dihedral burins have at least three burin blows on one of the burinated edges. About 80% of the burins have their burin blows placed on the distal, 11.4% on the proximal, and 5.7% on the lateral edges. Although the surface form of the spall removal varies considerably, the straight form dominates. A correlation analysis between burin raw materials and the surface forms of spall removals showed no relationship. This suggests that raw material types have no influence on the surface forms of burin spall

removals. The mean breadth for the burin cutting edges is 2.69 mm (sd. 1.85) and the mean angle for the burins is about 66°.

Outil écaillés. This category of shaped tool is considered by some researchers as the scaled pieces resulting from bipolar reduction (Dickson 1970). As recognized here, *outil écaillés* are those "flakes with crushing and stepped flaking restricted to the flake margin on one or opposing edges/faces" (Mehlman 1989, p. 138). All the scaled pieces classified as *outil écaillés* have either a single or multiple scaled edge parallel to the axis striking force. Only eighteen *outil écaillés* occur in the analyzed assemblage, forming 3.53% of all shaped tools. The most commonly used material is clear quartz (39%), followed by cloudy quartz (33%), and obsidian (28%). It is clear that fine grained lithic materials were more preferred for *outil écaillés*. The mean length for *outil écaillés* is 14.90 mm (sd. 5.01), mean breadth is 12.25 mm (sd. 4.27), and mean thickness is 3.49 mm (sd. 0.51). The mean platform angle is 90°.

About 54.7% of the *outil écaillés* have plain platforms, 27.3% have crushed, and 9.1% have faceted platforms. The platforms of one piece could not be determined. Both broad and restricted platforms occur, each forming 45.5% of the sample. Only 18.2% of the specimens have evidence of platform dorsal edge preparation. The majority of the *outil écaillés* have bi-direction, opposed dorsal scar patterns. Yet, other dorsal scar patterns such as uni-directional

parallel scars, uni-direction irregular scars, and radial dorsal scar patterns also occur. This suggests that blanks for *outil écaillés* were selected as they were needed, from blanks that resulted from different reduction strategies. The dorsal surfaces of all the *outil écaillés* have no cortex, suggesting a preference for non-cortical blanks.

Becs. There are 19 becs in the analyzed sample, forming 3.73% of the shaped tools. The dominant raw material for the becs is cloudy quartz (94.7%). Chert is represented by only one piece. Although flakes (42.1%) are the most common blanks for becs, there is no standardization in blank selection for becs because non-chipped blanks, such as cores (31.6%), a chunk (5.3%), and an angular fragment (5.3%) also occur. Other blank types are a Levallois flake (5.3%) and a blade (5.3%).

The mean length for becs is 33.25 mm (sd. 11.53), mean breadth is 24.26 mm (sd. 11.96), and mean thickness is 13.93 mm (sd. 10.72). The mean angle of retouch is about 71°. When compared to other retouched tools, becs show steep angles of retouch. Also, the selection of blanks is more casual (e.g., chunk, angular fragment) when compared to other shaped tools. The casual selection of blanks for becs is also reflected by the percentage of cortex on their dorsal surfaces; half of the becs are non-cortical. The other half have surfaces ranging from 1-100% cortex. Although many of the becs are marginally to semi-invasively (55.6%) retouched, semi-invasively (11.1%), and invasively retouched becs are

also present. Marginally (11.1%) retouched becs are rare. It is difficult to make a meaningful conclusion about the becs because of the small sample. Yet, the discussed attributes suggest that becs either were intended for heavy-duty functions or were casually manufactured.

Composite tools. These are shaped tools combining two or more tool types on the same blank. There are 10 composite tools, forming about 2% of all shaped tools. Three of the composite tools are scraper and backed, three are scraper and burin, one is backed and bec, and three are scraper and bec. The blank type for the composite tools includes flake (40%), blade (10%), and core (20%). The blank type for three composite tools (30%) could not be determined. Cloudy quartz (50%) is the most utilized raw material for composite tools. Other raw materials include fine grained quartzite (20%), clear quartz (10%), obsidian (10%), and chert (10%).

Cores

There are 714 cores, forming about 18% of the analyzed lithic assemblage. Typologically, thirteen kinds of cores occur in the analyzed assemblage (Table 9-4). All the types recognized here have been defined in detail by Mehlman (1989). On the basis of core reduction strategies, I classify the six-teen types of cores into four major reduction strategies: 1) cores that were reduced utilizing well defined single, double, or multiple platforms; 2) cores that were flaked utilizing the bipolar technique; 3)

peripherally reduced cores; and 4) amorphous or irregularly reduced cores.

Table 9-4: Types of Cores.

Core Type	N	% Total
Part-peripheral	50	7.00
Radial	73	10.20
Disc	49	6.60
Levallois	12	1.70
Pyramidal	22	3.10
Single platform	156	21.80
Opposed double platform	154	21.60
Adjacent double platform	11	1.50
Multiple platform	44	6.20
Platform/peripheral	9	1.20
Platform/bipolar	2	0.20
Bipolar	117	16.40
Amorphous	17	2.40

Platform Reduction Strategy

This production technique begins with the removal of a single flake from any side of the core using a well-defined platform or platforms. The defined platform or platforms can be either cortical (*i.e.*, the cortex surface of the core), plain (utilizing a former negative scar), or prepared (faceted). In the analyzed assemblage, this reduction strategy yielded five different types of cores. These include single platform, pyramidal, opposed double platform, adjacent double platform, and multiple platform cores.

Single platform core (SPC). There are 156 SPCs, forming about 21.80% of all analyzed cores. Technologically, Mehlman's (1989) diverse single platform and single platform/core scraper types fall under this class as both

utilize a well-defined platform area. The mean length for SPC is 24.15 mm (sd. 12.19), mean breadth is 17.72 mm (sd. 10.69), and mean thickness is 10.87 mm (sd. 6.90). The weight is variable, ranging from 0.1 gm to 180.9 gm. The mean, median, and mode weights are 11.43 gm (sd. 25.67), 3.3 gm, and 0.6 gm respectively. From the dimension and weight data it is possible to suggest that small raw materials were selected for SPCs. Yet, the analysis of the stages of core abandonment shows that 32% of the cores were exhausted, 45.1% were considerably utilized, and 22.9% were minimally utilized. Therefore, the small dimensions and weights of SPCs are more likely due to intensive utilization of cores, rather than selection of small raw materials.

The most common utilized lithic raw material is cloudy quartz, forming 68.6% of all the SPCs. Other utilized raw materials are clear quartz (27.6%), fine grained quartzite (1.9%), obsidian (1.3%), and chert (0.6%). About 19% of the cores were reduced from pebbles (rounded). The remainder were manufactured from angular blocks. The analysis shows that the initial form or shape of a raw material was not a factor in its selection for reduction. This assertion is supported by the large number of SPCs with irregular or amorphous forms (Figure 9-21). While rectangular shapes are well represented, discoid, pyramidal, and prismatic shaped SPCs are rare. The fact that any lithic raw material was selected for single platform reduction regardless of its

initial form or shape indicates a high technological sophistication by the Eyasi Basin knappers.

Although the majority of the SPCs showed no evidence of preparation of the platforms, a few have either faceted, invasively retouched platform edges, or rejuvenation scars. Many of the cores have flat platforms. The mean angle of the platforms is about 91°. This mean angle of intersection between the striking platform and the dorsal surface of the intended flake is too high for continual reduction of cores. When platforms of SPCs exceed 90°, it will always be difficult to remove more flakes from the core regardless of the core size. One reason why some SPCs were minimally utilized is because their angles exceeded 90° and they had to be abandoned. Flake is the dominant primary type of scars for many of the cores. Cores with blade or flake-blade primary scar are rare.

Although I attempted to count the number of flaking scars on each core, the undertaking was made difficult by the flaking nature of cloudy quartz which is the dominant raw material. Many of the cloudy quartz cores showed no clear scars of flake or blade removal. Only clear scars were counted. As such, the mean of three scars is a very minimal figure and no meaningful reduction sequences can be determined from the number of scar removals. As observed from the scars on the cores, many of the flakes or blades left the cores with a feather termination. The dominant flaking technique is direct percussion by using a hard

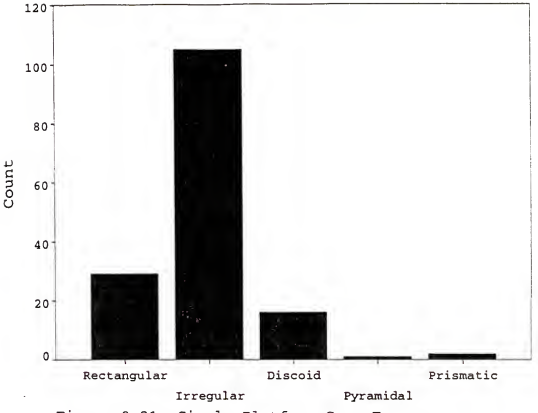


Figure 9-21: Single Platform Core Forms.

hammer. This reduction technique forms 84.3% of the sample. Indirect percussion is rare (15.7%). A cross tabulation of reduction techniques by raw material types shows that clear quartz was most favored for the indirect percussion technique (Table 9-5). This is possibly because of the good quality of clear quartz.

Table 9-5: Technique of Core Reduction by Raw Material Type.

	Direct Percussion	Indirect Percussion	%Total
Clear quartz	28	14	27.50
Cloudy quartz	96	9	68.60
Fine quartzite	3	0	2.00
Obsidian	1	1	1.30
Chert	1	0	0.70
Total	129	24	100.0

Pyramidal core (PC). There are twenty-two PCs, forming 3.1% of all analyzed cores. The mean length for PCs is 29.90 mm (sd. 18.70), mean breadth is 25.37 mm (sd. 15.79), and mean thickness is 20.20 mm (sd. 14.65). The mean weight is 42.41 gm (sd. 88.45). From the dimensions and weights of PCs, one would assume that large pieces of raw materials were selected for PCs. The results of the analysis of the stages of core abandonment however, show that more than half of the cores were minimally reduced (Figure 9-22). This minimal utilization of raw material may account for the large sizes and heavy weights of PCs.

The mean platform angle is about 87°. A cross tabulation analysis of platform angles by stages of core abandonment shows that nine of the fourteen minimally reduced cores have platform angles of $\leq 89°$. The minimal utilization of these nine cores cannot be explained by their platform angles as technically it was possible to continue reducing the cores. The analysis of raw material types shows that the most commonly utilized raw material for PCs is cloudy quartz, forming 72.7% of all the cores. The other utilized raw material is clear quartz (27.3%). During analysis, six of the PCs were noted to have internal flaws. Therefore, it is possible that many of the PCs were discarded early during reduction because of the nature and quality of cloudy quartz raw material rather than because of their dimensions or platform angles.

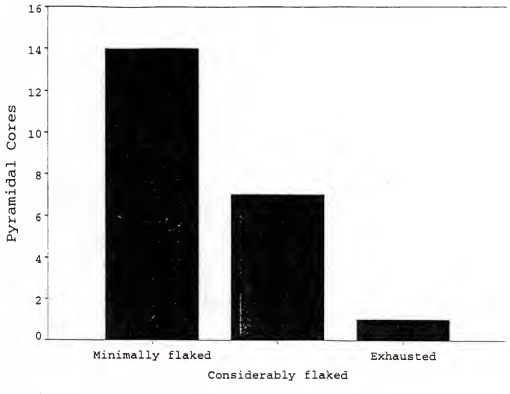


Figure 9-22: Stages of Core Abandonment.

Most of the raw material for PCs had initial pyramidal forms (77.3%), suggesting that lithic raw materials with initial pyramidal forms or shapes were favored for pyramidal reduction cores. Yet, lithic raw materials with initial prismatic (9.1%), irregular (9.1%), and rectangular (4.5%) forms also were utilized. About 77% of PCs have no evidence of platform preparation, 14% have invasive retouch on the platform edges, and 9% have faceted platforms. Cores with flat platforms comprise the majority, forming 91% of all PCs. Only 2 cores (9%) have convex platforms. Flake scars dominate among PCs. Yet, blade scars are also well represented, suggesting that pyramidal cores were favored for the production of blades. About 63.6% of the cores have non-feather termination of flakes, blades, or both. The occurrence of cores with hinge and step fractures is another

reason why many of the PCs were abandoned early during the manufacturing process.

About 82% of the cores were reduced by direct percussion technique and 18% were reduced using indirect percussion. The flaking scars and platforms suggest that hard hammers were used for the reduction process. This reduction technique forms 84.3% of the sample. Indirect percussion is rare (15.7%). The suggestion that raw material types possibly influenced the choice of core reduction technique is also supported by the cross tabulation of reduction techniques by raw material types. The results show that all four cores reduced by the indirect percussion technique are of clear quartz material.

Opposed double platform core (ODPC). There are 154 ODPCs, forming 21.60% of all cores. The mean length for ODPCs is 24.34 mm (sd. 12.42), mean breadth is 15.50 mm (sd. 10.15), and mean thickness is 9.94 mm (sd. 7.17). The mean weight is 10.31 gm (sd. 26.51). The mean platform angle is 91°. About 33% of the cores were exhausted, 57% were considerably flaked, and only 10% were minimally reduced. The analysis of raw material types shows that a wide range of raw material types was used for ODPCs. Although cloudy quartz dominates, it is clear from Figure 9-23 that fine grained materials that flake with a conchoidal fracture were sought for ODPCs.

About 46.7% of the ODPCs are rectangular in form, 46% are irregular, 4% are discoid, and 3.3% are prismatic. A

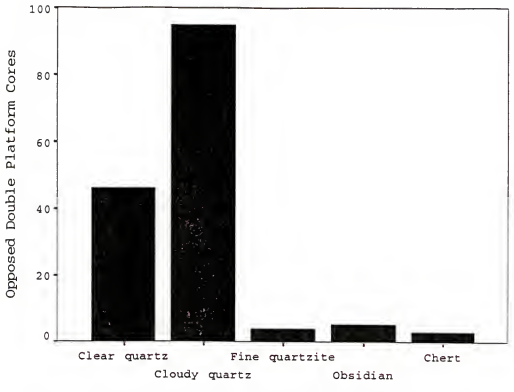


Figure 9-23: Raw Material Types for ODPCs.

cross tabulation analysis of core form by raw material type shows no evidence of choices for particular forms of raw material. The technique of core preparation played a minor role in ODPCs reduction strategy as indicated by the small numbers of ODPCs with prepared platforms. About 5.3% of the core platforms were faceted, 11.3% were invasively retouched on their edges, and 83% were plain. Although cores with flat platforms are the majority, a wide range of platform shapes occurs among ODPCs.

Flake scars dominate among ODPCs. Yet, blade scars are also well represented, suggesting that ODPCs were favored for the production of blades. The majority of the cores have feather flaking scars. Cores with stacked step fractures are lacking. This may explain why we find many exhausted and considerably flaked cores among ODPCs. Technologically, I

would assume that it was the high angle of platform (≥ 90°) that caused knappers to abandon the cores. The direct percussion technique using a hard hammer was the dominant reduction technique among ODPCs, forming 73%. Indirect percussion is represented by 27% of the cores. Of the forty ODPCs that were reduced using the indirect percussion technique, twenty-one are clear quartz raw material, thirteen are cloudy quartz, five are obsidian, and one is chert. This further supports the suggestion that raw material type and quality quite logically influenced the choice of core reduction techniques in the Eyasi Basin.

Adjacent double platform core (ADPC). There are eleven ADPCs, forming 1.54% of all cores. The mean length for ADPCs is 29.21 mm (sd. 17.30), mean breadth is 20.95 mm (sd. 7.82), and mean thickness is 15.53 mm (sd. 6.20). The mean weight is 15.28 gm (sd. 18.74) and the mean platform angle is 91°. The majority of ADPCs are considerably flaked (54.5%). Yet, minimally flaked cores also form a large proportion (36.4%) of ADPCs and exhausted cores are rare (Figure 9-24). This may explain the reason behind the large means of dimension and weight for the ADPCs. Only two types of raw materials were utilized for ADPCs, cloudy quartz (73%) and clear quartz (27%). This may be a reflection, however, of a small sample rather than conscious choices by prehistoric knappers.

Both rectangular and irregular forms are equally represented, each forming 36.4% of the sample. Discoid and prismatic forms comprise 9.1% and 18.2%, respectively.

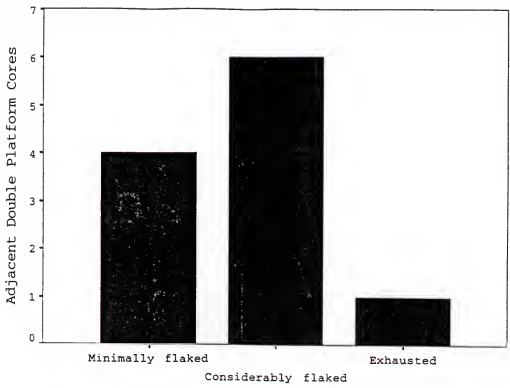


Figure 9-24: Stages of Core Abandonment.

Again, there is no clear evidence of choices of particular forms of raw material. Only one core has a faceted platform, the remainder have plain unprepared platforms. The majority of the cores have flat platforms (91%), and cores with convex platforms form only 9% of the sample. Most of the flaking scars are of flakes in origin (82%). Flake-blade scars form only 18% of the sample, suggesting that ADPCs were favored for the production of flakes. The occurrence of hinge and step fractures in the cores may also explain why many minimally flaked cores occur among ADPCs. Technologically, I assume that it was a combination of high angle of platform ($\geq$ 90°) and the occurrences of step and hinge fractures that caused knappers to abandon the cores in the early stages of manufacture. All the analyzed ADPCs were reduced by the direct percussion technique using a hard hammer.

Multiple platform core (MPC). There are 44 MPCs, forming about 6.2% of the core sample. The mean length for MPCs is 38.84 mm (sd. 18.68), mean breadth is 30.92 mm (sd. 16.35), and mean thickness is 18.20 mm (sd. 12.24). The mean weight is 48.31 gm (sd. 61.83) and the mean angle of the major platform is about 91°. The majority of MPCs are considerably flaked (57%). About 29% of the cores are minimally flaked and only 14% are exhausted (Figure 9-25).

Figure 9-25: Stages of Core Abandonment.

The considerable and minimal utilization of cores, when combined, can account for the large mean dimensions and weight of MPCs. Yet, it is possible that large raw materials were selected for MPC reduction strategy. In fact, I would think that a large piece of raw material would be preferred for a MPC because it provides a large surface area for

flaking from different directions. A range of raw materials was utilized. These include cloudy quartz (56.8%), chert (20.5%), clear quartz (13.6%), fine grained quartzite (6.8%), and obsidian (2.3%).

Irregular cores dominate, forming about 60% of the sample. Rectangular, discoid, and prismatic cores form 19%, 14%, and 7%, respectively. Clearly any form of initial raw material was utilized for the MPCs. About 10% of the cores have faceted major platforms, 14% have invasive retouch on the edges of the major platforms, and 76% have unprepared major platforms. The majority of the cores have flat major platforms (88%), 6.8% have convex, and 4.5% have irregular major platforms. Cores with flake scars dominate (93%). Cores with flake-blade scars form only 7%. This suggests that more flakes were produced from MPCs than blades. Only 32% of the cores have scars with feather termination. The rest have scars with either step (4.5%) or a combination of feather, hinge, and step termination (47.6%). About 93% MPCs were reduced by direct percussion technique using a hard hammer. Only 7% were reduced using the indirect percussion technique.

Bipolar Reduction Strategy

In this reduction technique, the cobble (raw material) to be reduced is held firmly against a stone anvil and then struck directly by a hard hammer on the top. The force waves from the hard hammer and the anvil can cause the removal of

one or more flakes at once from one or each end of the cobble. The cores resulting from this reduction strategy are known as bipolar cores (BCs).

There are 117 BCs, forming 16.4% of the analyzed core sample. The mean length for BCs is 24.88 mm (sd. 12.87), mean breadth is 16.13 mm (sd. 9.91), and mean thickness is 9.03 mm (sd. 12.24). The mean weight is 10.78 gm (sd. 40.71) and the mean angle of the major platform is about 91°. About 55% of BCs are exhausted, 37% are considerably flaked, and only 8% are minimally flaked. Only three types of raw materials were utilized for BCs. These include cloudy quartz (73.5%), clear quartz (23.1%), and fine grained quartzite (3.4%).

Rectangular cores dominate, forming about 66% of the sample. Irregular, discoid, and prismatic cores form 31%, 1%, and 2% respectively. The results indicate that rectangular forms of raw materials tended to be selected for the bipolar reduction strategy. The majority of the cores (90%) have unprepared platforms and 10% have invasively retouched platform edges. Nevertheless, the invasive retouch on the edge may be due to step fractures caused by either the anvil or hammer rather than actual retouch of platform edges. Although flat platforms dominate (70%) among BCs, convex platforms are also well represented (40%). Also found are BCs with convex (5%) and pointed (1%) major platforms. Both flakes and blades were produced by the bipolar core reduction strategy. About 52% of BCs have scars with a feather

termination, 12% have hinge, 17% have feather-hinge, 11% have feather-step, 3% have hinge-step, and 6% have feather-hinge-step termination. Direct percussion using the bipolar technique is the dominant reduction strategy, forming 91% of all BCs. Indirect percussion BCs form only 9%.

Peripheral Reduction Strategy

This reduction strategy utilizes a well-defined peripheral edge as the striking platform. The core is peripherally reduced by using as a striking platform a scar of a formally removed flake. When the core is consistently and systematically reduced on both faces, this reduction strategy results in symmetric and more-perfect geometric cores. Cores such as radial/biconical, disc, Levallois, and part-peripheral belong to this more complex reduction strategy group. Also, the manufacture of bifaces and the so called chopping tools require the employment of the peripheral reduction strategy.

Radial core (RC). There are seventy-three RCs, forming about 10% of the total core sample. The mean length for RCs is 33.24 mm (sd. 16.95), mean breadth is 27.77 mm (sd. 13.13), and mean thickness is 17.46 mm (sd. 10.30). The mean weight is about 32 gm (sd. 26.51) and the mean angle of the major platform is about 89°. Most of the cores are considerably flaked (69%), 21% are minimally reduced, and 10% are exhausted. A wide range of locally available lithic raw materials was utilized for RCs. These include clear quartz

(11%), cloudy quartz (72%), fine quartzite (4%), basalt (3%), and chert (10%).

About 84.3% of the RCs are discoidal in form, 14.3% are irregular, and 1.4% are prismatic. A cross tabulation analysis of core form by lithic raw material form shows that about 76% of the cores were reduced from angular blocks and only 24% were reduced from rounded pebbles. Therefore, the initial form of lithic raw material (e.g., irregular or angular block versus rounded pebbles) did not prevent knappers from systematically reducing the raw material to produce more perfectly geometric RCs.

The technique of core preparation was important in the RC reduction strategy. About 16% of the core platforms were faceted, 6% were invasively retouched on their edges, and 77% were plain. Although cores with convex major platforms are the majority, other forms of major platforms also occur among RCs. About 94% of RCs have flake scars. This indicates that RCs were reduced primarily for the production of flake blanks. Only seventeen cores have feather scar termination; the remainder have either hinge, step, or a combination of feather, hinge, and step fractures. The occurrence of hinge and step fractures, and the combination thereof, explain why only a small number of RCs were exhausted. Although many of the major platform angles would have permitted further reduction of the cores, the occurrence of hinge and step fractures prevented knappers from further reducing the cores. About 99% of the cores were reduced by a free hand direct

percussion, using a hard hammer. Indirect percussion is an insignificant technique in this peripheral reduction strategy.

Disc core (DC). There are forty-seven DCs, forming about 6.6% of the core sample. The mean length for DCs is 44.06 mm (sd. 20.48), mean breadth is 39.77 mm (sd. 18.47), and mean thickness is 20.41 mm (sd. 13.77). The mean weight is about 68.60 gm (sd. 5.84) and the mean angle of major platforms is about 86°. The number of exhausted cores is higher (45.7%) in DCs than in any other analyzed core type. Considerably flaked cores form 47.8% of the DCs sample; only 6.5% are minimally flaked. Although four varieties of locally available lithic raw materials were utilized, cloudy quartz dominates (Figure 9-26).

The forms of DCs are limited ,as 98% are discoidal and 2% are irregular in form. A cross tabulation analysis of core form by lithic raw material form shows that about 89% of the cores were reduced from angular blocks while only 11% were reduced from rounded pebbles. Therefore, the initial form of lithic raw material (e.g., irregular or angular block versus rounded pebbles) did not prevent knappers from systematically reducing the raw material to produce more-perfect geometric DCs. This indicates a high standardization and sophistication in core reduction strategy. About 13% of the core platforms were faceted, 24% were invasively retouched on their edges, and 63% were plain. This suggests

that the technique of core preparation was also utilized in the reduction strategy of DCs.

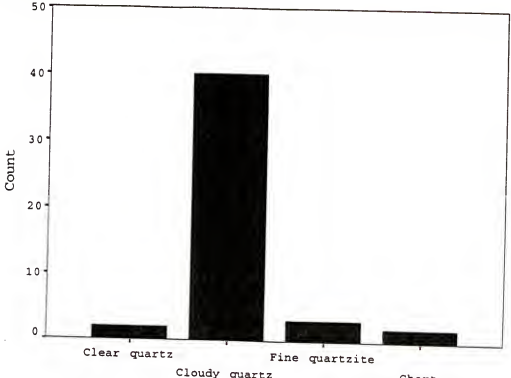


Figure 9-26: Raw Material Types.

Most of the cores have convex major platforms (47%). Yet, cores with flat major platforms are also well represented, forming 42% of the sample. Cores with concave major platforms are rare (11%). About 96% of the DCs have flake scars. This indicates that DCs were reduced primarily for the production of flake blanks. Only eleven cores have feather flaking termination and the rest have either hinge, step, or a combination of feather, hinge, and step fractures. About 96% of the cores were reduced using a free hand direct percussion, with a hard hammer. Indirect percussion is rare (4%).

There are two types of DC reduction. In the first case, the cores were unifacially flaked, using a split surface as

the face for flake removal. DCs resulting from this reduction were flat and lenticular in cross-section. The non-reduced face was always almost 100% cortical. In the second case, the cores were bifacially flaked using the outer edges as the platforms from which flakes were struck, usually all the way around the periphery of the core. The DCs resulting from this reduction strategy are high backed with little or no cortex and are usually biconvex in cross-section.

Part-peripheral core (PPC). There are fifty PPCs, forming 7% of the analyzed core sample. The mean length for PPCs is 29.55 mm (sd. 12.43), mean breadth is 26.62 mm (sd. 9.68), and mean thickness is 18.80 mm (sd. 9.64). The mean weight is about 26 gm (sd. 36.02) and the mean angle of major platforms is about 90°. The number of minimally reduced cores is higher (64%) in PPCs than any other analyzed core type. Considerably flaked cores form 32% of the PPC sample and exhausted cores are rare (4%). Cloudy quartz is the dominant lithic raw material for PPCs, forming 86% of the cores. Other utilized raw material includes clear quartz (8%), fine quartzite (4%), and chert (2%).

Like DCs, PPCs are also limited in form; discoidals (76%) and irregulars (24%) are the only recognized core forms. A cross tabulation analysis of core form by lithic raw material form shows that about 62% of the cores were reduced from angular blocks and 38% were reduced from rounded pebbles. The result suggests that prehistoric knappers were

technologically capable of reducing any form (e.g., irregular cobbles) of raw material using the peripheral reduction strategy.

Most of the cores have irregular major platforms (54%). Yet, cores with flat major platforms are also well represented, forming 42% of the sample. Cores with concave major platforms are very rare (4%). About 96% of the PPCs have flake scars. This indicates that PPCs were also reduced primarily for the production of flake blanks. About 12% of the cores have feather flake termination and the rest have either hinge, step, or a combination of feather, hinge, and step fractures. All PPCs were reduced by a free hand direct percussion, using a hard hammer.

Levallois core (LC). There are only twelve LCs, forming about 1.7% of all the core sample. The mean length for LCs is 31 mm (sd. 10), mean breadth is 26 mm (sd. 10.56), and mean thickness is 12 mm (sd. 3.71). The mean weight is about 12 gm (sd. 10.28) and the mean angle of major platform is about 89°. Seven of the LCs were exhausted and the other five were considerably flaked. A variety of locally available and "exotic" lithic raw materials were utilized for LCs. These include cloudy quartz (33%), clear quartz (25%), chert (25%), fine quartzite (8.3%), and obsidian (8.3%).

LCs occur in a variety of forms. About 80% of them are discoidal in form, 9% are irregular, 9% are rectangular, and 9% are prismatic. A cross tabulation analysis of core form by lithic raw material form shows that about 73% of the cores

were reduced from angular blocks and 27% were reduced from rounded pebbles. Therefore, the initial form of lithic raw material (e.g., irregular or angular block versus rounded pebbles) has no influence on the form of the discarded core.

The technique of core preparation was more important in the LCs than in any of the preceding cores. This is indicated by a high percentage of faceted platforms. About 46% of the cores have faceted major platforms, 9% have invasively retouched major platforms, and 45% have unprepared major platforms. Most of the LCs have convex platforms (73%). Other cores have flat (9%), concave (9%), and pointed (9%) major platforms.

All the LCs have flake scars indicating that LCs were reduced primarily for the production of flake blanks. Five of the cores have feather scar termination and the rest have either hinge, step, or a combination of feather, hinge, and step fractures. All the LC cores were reduced by a free hand direct percussion, using a hard hammer.

Amorphous Reduction Strategy

This group is composed of clearly flaked cores, but the reduction strategy could not be discerned. This unsystematic core reduction always results in cores that defy even typological classification. In the Eyasi Basin, such cores are classified by Mehlman (1989) as amorphous cores.

There are seventeen amorphous cores (ACs), constituting about 2.4% of the core sample. The mean length for ACs is

30.25 mm (sd. 21.50), mean breadth is 24.29 mm (sd. 15.13), and mean thickness is 13.56 mm (sd. 8.40). The mean weight is 30 gm. Only one core had a clear major platform with an angle of about 102°. The utilized raw material includes cloudy quartz (82%), clear quartz (6%), fine grained quartzite (6%), and granite (6%). All of the ACs were minimally and discontinuously reduced or spalled with ≥ 51% ≤ 90% cortex. This reduction strategy suggests some sort of irregularities in executions. When compared to the preceding core reduction strategies, there is a considerable departure from what I consider to be recurring regularity, high precision in production, and elaborate sophistication in concept and practice.

Summary

The lithic analysis provides evidence to support the existence of a patterned hominid behavior in the Eyasi Basin that appears to be stable through time. I assume lithic raw material transport to be one of the correlates of past mobility and land-use strategies. Thus, the contrast between raw material transport patterns in the Eyasi Basin between the observed different cultural stages ("Njarasan", MSA, and PN) should reflect differences in the mobility and land-use strategies to meet vital survival needs. These differences may be considered the expressions of fundamentally different behavioral capacities that would also be manifested in other domains, such as the overall techno-economic behaviors.

In this chapter, I have identified two patterns of lithic procurement and use: localized and non-localized. Yet, the localized pattern of procurement and use is most common, as only 2.78% of the counted artifacts are non-local. This local procurement and use does not appear to have changed significantly across any of the observed cultural stages in the Eyasi Basin. In fact, if there was any change, then it was across the "Njarasan"/ MSA. Many of the "Njarasan" artifacts recovered and analyzed are made of basalt and fine grained phonolite. Fine grained phonolite is a non-local material and its source is about 72 km north of the Eyasi Basin. Obsidian, a non-local material, was not found among the "Njarasan" artifacts. In the MSA, basalt and phonolite artifacts are rare; in the LSA and PN basalt and phonolite artifacts are almost non-existent. Obsidian occurs in the MSA, LSA, and PN cultural stages. Yet, in all three cultural stages, obsidian artifacts are rare. In spite of knowledge of the availability of fine grained lithic materials (e.g., phonolite, chert, etc.) in neighboring areas (e.g., Olduvai, Englosen Hills, Natron Basin), there is no evidence to suggest that these materials were increasingly sought for artifact production across the MSA/LSA transition. Instead, locally available, poor quality quartz persisted through time as the most commonly used lithic raw material. The persistence through time (MSA->LSA->PN) of a regionally patterned behavior of local raw material procurement and use

bears witness to underlying elements of hominid behavioral stability and continuity in the Eyasi Basin.

Binford notes that "the procurement of raw material is embedded in basic subsistence schedules" (1977, p. 259). If this is true, then there should be no significant differences in land-use and mobility behaviors between MSA and LSA foragers. This is because the same local procurement and uses of lithic resources by MSA and LSA foragers often might have been concurrent with the land-use and mobility systems inherent in the subsistence patterns.

The availability of local raw materials enabled both MSA and LSA foragers to combine "casual" and "systematic" core reduction strategies. Casual technology is reflected by the amorphous cores and tools that were shaped from chunks or cobbles. Such casual tools and cores were probably produced on an immediate-need basis and discarded immediately after their use at the activity areas.

The systematic reduction strategy did not conform to a single method; rather three methods (platform, peripheral, and bipolar) of flake production were employed. Although the bipolar technique can be considered as a simple flaking or smashing technique, when consistently applied it results in regular bipolar cores.

The governing mode of the systematic core reduction in the Eyasi Basin was essentially the utilization of a former flake or blade scar as the striking platform for a new flake or blade. Two techniques were employed for the systematic

reduction: platform and peripheral reduction techniques. Depending on the number of available platforms and their locations on a piece, the platform reduction technique resulted in cores that are classified as SPC, ODPC, ADPC, and MPC. Depending on the coverage of the flaked edge, preparation of major platform, and cross-section (flatness) of the reduced piece, the peripheral reduction strategy resulted in cores that are classified by archaeologists as DC, PPC, RD, and LC. With the exception of the LC that is rare and theoretically restricted to either the MSA or MSA/LSA cultural stages, the other cores occur in all the cultural stages in the Eyasi Basin. This suggests a "continuity" in some aspects of lithic technology that is probably influenced by a patterned regional behavior regarding lithic raw material procurement and use.

The strategies of systematic reduction of cores produced blanks that were later retouched into shaped tools. As shown in this chapter, a variety of shaped tool categories were produced. These include scrapers, backed pieces, points, becs, *outil écaillés*, and heavy-duty tools. While backed pieces are restricted to the LSA and later cultural stages, points occur largely in the MSA times and to some extent in the MSA/LSA cultural stage. Yet, as shown in Chapters 7 and 8, and in Mehlman (1989), scrapers and some heavy-duty tools occur throughout the Eyasi Basin cultural sequence. Such occurrences suggest that for whatever needs (cultural, functional, ecological, economic, etc.) scrapers were

produced, and that such needs did not significantly change, at least in the Eyasi Basin. The inference is that MSA and LSA foragers in the Eyasi Basin possibly manufactured scrapers for similar functions.

Within each tool category (e.g., scraper), a range of tool types existed. While I concur with Dibble (1995) that the tool types recovered archaeologically may not necessarily represent desired end products, the Eyasi Basin scrapers do not support his scraper edge re-sharpening model as the cause of the different scraper types we found. As shown in this chapter, most of the Eyasi Basin scrapers have marginal (< 2 mm) to semi-invasive (2-3 mm) retouches with no evidence of re-sharpening. The only tools observed to have evidence of edge re-sharpening were two chert scrapers from the surface. Since most of the scrapers are made of cloudy quartz, edge re-sharpening would not have been favored because of the uncertainty of the outcome due to the inconsistent quality of quartz. Moreover, in the Eyasi Basin where lithic material is locally available and abundant, edge re-sharpening of quartz tools to extend their use value would not, in my opinion, be necessary.

I also contend that the morphological type lists archaeologists construct do not necessarily reflect natural groupings of artifact morphologies. Rather, I feel that stone tools were produced and discarded in different areas according to different contexts and needs. The morphology of the stone tools we study was generated given multiple factors

that may differ from one area to another. Unless we understand these local contexts (e.g., lithic material availability, available technology, human relationships, discard patterns, etc.) and the needs for tools (e.g., subsistence, etc.), our understanding of lithic variability during the MSA will always be incomplete.

Although lithic materials are locally available and abundant in the Eyasi Basin, many of the cores were considerably reduced and exhausted. This indicates a frugal behavior toward raw material utilization. Moreover, it also indicates high precision and complexity in lithic reduction by the Eyasi Basin MSA and LSA foragers. This is illustrated by the many platform and peripherally flaked cores.

Dickson (1977) has reviewed the problems associated with the reduction of quartz. He has shown that the direct percussion bipolar technique is the only technique that can be satisfactorily applied. His comment that indirect percussion is not likely to be used in reducing quartz material, however, is not supported by the Eyasi Basin material. Although indirect percussion may have played a minor role in the Eyasi Basin technology, nonetheless, the technique was utilized to reduce quartz.

In summary, the analyzed lithic artifacts indicate a patterned behavior toward lithic technology and raw material procurement and use in the Eyasi Basin This behavior appears to be stable through time, suggesting some elements of continuity across the MSA/LSA. MSA and LSA foragers

maintained essentially similar use and constant access to the abundant, local raw material sources in the Eyasi Basin. In Chapter 10, I will examine whether or not this regionally patterned adaptive behavior would also have placed both MSA and LSA foragers in the surveyed areas.

CHAPTER 10
IMPLICATIONS AND CONCLUSIONS

Introduction

This chapter discusses the general implications of the research, summarizes the findings, and conclude by providing suggestions for future research needs. In discussing the implications of the research, my major goals are to test the formulated hypotheses and infer about MSA and LSA forager land-use and adaptations in the Eyasi Basin. First, I examine the distribution and patterning of forager surface lithic artifacts and explore their implications for MSA and LSA forager land-use and adaptations in the Eyasi Basin. A second issue concerns the occurrences and patterning of the sub-surface artifacts and their implications for the surface artifacts and hominid land-use and adaptations in the Eyasi Basin. Third, I will explore further the link between forager land-use and lithic raw material procurement and use in the Eyasi Basin. Finally, I will infer the organization of lithic technology in the Eyasi Basin.

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Introduction

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Implications for Hominid Land-Use and Adaptations

The Surface Artifacts

In order to understand how prehistoric foragers used the Eyasi Basin, it is necessary to examine the surface lithic landscape, *i.e.*, the cultural distribution of stone artifacts across the landscape. The information about the distribution of stone artifacts in the surveyed areas is important, particularly in identifying how MSA and LSA foragers organized and used the Eyasi Basin. This information will be used to test the "continuity" or "change" model in foragers land-use and adaptive systems as hypothesized in Chapter 6. Although the surveyed areas represent a fraction (20.05 km^2 or 0.82%) of the Eyasi Basin, they are viewed here as representative samples in a dynamic spatial system of lithic raw material procurement, artifact manufacture, use, and discard.

In Chapter 7, I reported that stone artifacts were recovered in all of the surveyed areas, except Survey Area 8. Although I argued in Chapter 7 that the lack of surface artifacts in Survey Area 8 may be attributed to the burial and redepositional processes, it may also indicate minimal or no utilization of this area by prehistoric foragers. All the other thirteen surveyed areas yielded stone artifacts that varied in densities, ranging from isolated scatters to low density to high density artifact scatters. Nonetheless, low

density artifact scatters were the most common distribution pattern of surface artifacts in the majority (64%) of the surveyed areas. Such variations in surface artifact densities suggest, among other things, that some locations in the surveyed areas were used more than others. Most of the high density surface scatters occurred around rock shelters reflecting extensive utilization of rock shelters and their vicinities. This indicates the importance of rock shelters as habitation places in the land-use systems of prehistoric foragers.

The distribution and patterning of the surface lithic scatters in the thirteen surveyed areas represents a range of cultural stages, including the "Njarasan", MSA, LSA, and PN materials (see Chapter 7). For example, high density surface scatters of "Njarasan" materials were found in Survey Area 4, while low densities were found in Survey Areas 1, 2, 3, and 5. Furthermore, Survey Areas 6, 7, 13, and 14 yielded isolated surface scatters of "Njarasan" materials.

Regarding MSA and LSA artifacts, both high and low densities, and isolated surface scatters of these two cultural stages were found in Survey Areas 1, 2, 6, and 7. Survey Areas 3 and 4 both yielded low density and isolated scatters of both MSA and LSA materials. Survey Area 5 yielded MSA, but not LSA artifacts. Isolated MSA and low density LSA artifacts were found in Survey Areas 9, 10, 11, 12, 13, and 14. In terms of PN material, eleven of the thirteen surveyed areas with artifacts yielded high density

to low density surface scatters of the PN cultural stage (Chapter 7). Stone cairns, possibly of the IA cultural stage, were found in Survey Area 3 and 6. Furthermore, items of Hadzabe material culture, abandoned overnight camps, or short term residential bases were found in eight surveyed areas. Items of modern pastoral Iraqwi people were found in Survey Areas 1 and 6.

The distribution of surface artifacts in the majority of the surveyed areas reflects, therefore, patterns of land-use by both "Njarasan", MSA, and LSA foragers; PN people; and Hadzabe foragers. Although interpretation of the surface artifacts is subject to predicted patterns of hominid behaviors, this also can be caused by surface and sub-surface formation processes. Consequently, behavioral interpretation of the surface artifact patterning is complicated by non-behavioral formation processes. Nonetheless, as argued in Chapter 7, if the formation processes in the Eyasi Basin had any adverse effects at all on the patterning of the surface artifacts, would have been either to reduce the artifact densities through erosion processes or re-deposit the surface artifacts through deposition processes. In any case the erosion and depositional processes would not have destroyed or significantly disturbed the patterning of the surface artifacts. Therefore, behavioral interpretation of the Eyasi Basin surface artifacts is possible.

The occurrences of low density and isolated artifact scatters throughout the surveyed areas demonstrate the

continuous spatial use of the Eyasi Basin landscape by prehistoric people. Many of the locations of low density to isolated artifact scatters had limited amounts of debris associated with tool manufacturing, probably indicating that tools were brought to the locations as part of a mobile toolkit with minimal tool repair and maintenance.

Locations of high artifact density (e.g., around and inside rock shelters) suggest that they were repeatedly utilized. These locations of high density artifact scatters contained abundant debris (e.g., angular fragments, flakes, cores, shaped tools, etc.) of tool manufacturing and maintenance, indicating that they served as short term residential bases and that they were reoccupied possibly in a way similar to modern Hadzabe use of rock shelters as indicated by the debris of Hadzabe arrow shaft manufacturing or maintenance in some of the occupied rock shelters (see Chapter 5). Nonetheless, the distributions of artifacts across the surveyed areas goes beyond the locations of high densities, suggesting that human activities were not confined to particular spaces of the Eyasi Basin landscape.

Since both MSA and LSA artifacts occur in twelve of the fourteen surveyed areas, it is inferred that the overall organization of land-use by both MSA and LSA foragers appears to have been similar. This suggests that whatever cultural changes (e.g., change from MSA to LSA) that may have occurred over time in the general pattern of hominid adaptation in the Eyasi Basin, those changes seem to have placed MSA and LSA

foragers in the surveyed areas for similar purposes. Accordingly, the land-use patterns of MSA and LSA foragers in the Eyasi Basin were not remarkably different, indicating perhaps greater "continuity" or "gradual" changes in the organization of the two foraging systems. The occurrences of both MSA and LSA artifacts in twelve of the fourteen surveyed areas, therefore, supports rejecting the hypothesis that forager utilization of the Eyasi Basin changed in extent and structure during the MSA and LSA. The inference is that MSA foragers of the Eyasi Basin had behavioral and cognitive abilities that were comparable to those shown by LSA foragers.

The continuity in forager usage of rock shelters from MSA times to LSA suggests not only that the same "modern" people were involved, but also that they had similar behavioral and cognitive capacities. The inferred shared perception of the Eyasi Basin landscape and its resources by both MSA and LSA foragers suggests that the potentials for some "modern" behavioral capacities were already in place during the MSA.

Because land-use is closely attuned to resource distributions, I would argue that the factors that placed MSA and LSA foragers in the same sections of the Eyasi Basin landscape were resource utilization. If MSA foragers did not respond to ecological changes in the same manner as LSA foragers (Ambrose and Lorenz 1990), I would expect that the utilization of resources in the Eyasi Basin by MSA foragers

would have been different from that of LSA foragers. This would have resulted in different land-use systems between the MSA and LSA foragers. In contrast, the distribution of MSA and LSA artifacts across the landscape indicate similar land-use systems between the MSA and LSA. This suggests that forager systems of land-use and resource utilization in the Eyasi Basin did not change remarkably at the MSA/LSA transition. This "continuity" in the use of the Eyasi Basin landscape calls into question the held assumption that the MSA/LSA transition marks major behavioral differences between MSA and LSA hominids. The surface lithic scatters collected in our survey reflect similar patterns of land-use by MSA and LSA foragers, regardless of the supposed shift in behavior at the MSA/LSA transition.

Ecological Model

As suggested earlier, the high to low density MSA and LSA surface scatters in Survey Areas 1-7 indicate multiple utilization of the surveyed areas. All these areas occur in Landscape Area I (see Chapter 2). These high to low density artifact scatters support the prediction of the ecological model of differential land-use in the Eyasi Basin. The model predicted that due to its reliable and abundant food resources, Landscape Area I would have provided the most opportunities for forager survival during the dry and wet seasons of the arid climate and during the wet season of the humid climate (Chapter 2). These multiple occupations of

Landscape Area I would have resulted in high densities of forager items of material culture. Indeed, all the surveyed areas in Landscape Area I yielded high to low density scatter of surface artifacts, supporting the predictions of the ecological model of forager land-use in the Eyasi Basin.

The isolated MSA artifact scatters in Survey Areas 10-14 also supports the ecological model of forager land-use patterns in the Eyasi Basin. These surveyed areas occur in Landscape Areas II and IV. As the model predicted, Landscape Area II and IV would have been used only during the wet season of the arid climate and during the dry and wet seasons of the wet climate. Nonetheless, since not all foragers would have left Landscape Area I (except during the wet season of the wet climate, see Chapter 2) and since foragers would have dispersed in small groups, the model predicted that Landscape Area II and IV would exhibit low to isolated densities of artifact scatters. The isolated nature of the MSA surface artifacts in the surveyed areas of Landscape Area II and IV clearly supports the prediction of the model. The distribution of LSA artifacts, however, does not wholly support the model as LSA artifacts occur in the surveyed areas in Landscape II and IV as low to high density scatters. This indicates either an increase in population density of LSA foragers as compared to MSA or all LSA foragers abandoned Landscape Area I in favor of Landscape Area II and IV during the wet season of the dry climate and during the dry season of wet climate.

The Subsurface Artifacts

It is clear from Chapters 7 and 8, that the surface and sub-surface record differ in terms of the composition of the artifacts and the cultural stages they represent. As described in Chapter 7, many of the surveyed areas yielded "Njarasan", MSA, LSA, and PN artifacts. Nonetheless, only one shelter, Gordfani 2, yielded MSA, LSA, and PN materials. The other shelters yielded either LSA and PN materials or PN materials only. The behavioral or geomorphological meanings of these differences between the surface and subsurface archaeological records are not clear. One could contend that many of the rock shelters occupied by MSA and LSA foragers were short term residential areas and were not necessarily reoccupied. Therefore, little or no activity debris would have accumulated in the shelters. In this context, the role of surface survey and surface artifacts for understanding MSA and LSA forager land-use and adaptive systems in the Eyasi Basin is self-evident. Without this surface survey, the recognition of continuous spatial utilization of the Eyasi Basin by both MSA and LSA foragers would not have been possible.

In chapter 6, I contended that the hypothesis about the "continuity" or "change" in land-use patterns between MSA and LSA foragers would also be tested by the excavated lithic assemblages. I predicted that, where deep archaeological deposits exist, LSA artifacts would be found stratified above

MSA materials. As described in Chapter 8, only one shelter, Gordfani 2, yielded a long archaeological sequence. The majority of the excavated shelters, especially those in the Siponga-Masiedha Hills, had shallow archaeological deposits and they yielded predominantly Holocene LSA and PN materials. The occurrence of shallow archaeological deposits in the rock shelters of the inland landscape (Landscape Area II and IV) appears to support the ecological model of forager land-use that foragers would have dispersed in small groups during the use of this area because of the many rock shelters. The exposed bedrock in many of the shelters also would have prevented foragers from producing large amounts of debris on the floors. The small amount of debris produced during the short occupation periods was probably discarded beyond the shelter's dripline as is done by Hadzabe foragers today (see Chapter 5). Nonetheless, it is possible to test the hypothesis about "continuity" or "change" in the land-use system of the Eyasi Basin using Gordfani 2 and Mumba rock shelter (Mehlman 1989).

The Gordfani 2 and Mumba rock shelters are both located in the northeast of the Eyasi Basin of Landscape Area I. The archaeological sequence at Mumba rock shelter includes MSA, MSA/LSA transition, late Pleistocene LSA, Holocene LSA, PN, and IA materials (Mehlman 1989; see summary in Chapter 4). Although the sample is small and the ^{14}C dates indicate intrusive charcoal to accurately place the Gordfani 2 material into the Eyasi Basin sequence, it is clear that

Gordfani 2, contains MSA, LSA, and PN materials. In addition, Gordfani 2 as well as Endanyawishi 1 and 2 and Qhadenaqwete 1, 2, and 3, contained Hadzabe items of material culture in the upper levels. The occurrence of both MSA, LSA, PN and IA materials at Mumba and the occurrence of MSA, LSA, PN, and Hadzabe materials at Gordfani 2 demonstrate the continuous utilization of some rock shelters by the Eyasi prehistoric and modern inhabitants. This suggests that, despite good evidence for substantial cultural change over time in the Basin, the pattern of human utilization of rock shelters does not appear to have changed.

The continuous use of rock shelters by Hadzabe foragers as overnight camps and residential bases during the rainy seasons has important implications for the understanding of hominid land-use and adaptations in the Eyasi Basin. The occurrences of both MSA and LSA materials in rock shelter deposits show that rock shelters were important features of MSA and LSA foragers land-use and adaptation in the Eyasi Basin, regardless of the temporal differences. Whatever factors (e.g., ecological, cultural, etc.,) caused foragers to occupy rock shelters in the Eyasi Basin, both MSA and LSA foragers responded in the same manner. This suggests that although the temporal span may be different, MSA and LSA foragers responded similarly to similar environmental factors. Ultimately, this indicates that the response systems or adaptations of MSA and LSA to similar environmental factors in the Eyasi Basin were not

significantly different in terms of basic biological needs. The inference is that, MSA and LSA foragers in the Eyasi Basin shared basic behavioral or physiological responses. This implies that if there are any differences in behavior in the archaeological record between the MSA and LSA, then those differences most likely may be due to different inducements.

The modern occupation of rock shelters in the Eyasi Basin as described by Hadzabe foragers is generally limited to times of heavy rains and occasionally as overnight camps during hunting and gathering missions (see Chapter 5). Although I hypothesized that MSA and LSA foragers used the Eyasi Basin rock shelters in similar ways, this hypothesis cannot be tested by the available data.

Since rock shelters are fixed in the landscape, their relative state of comfort is known in advance by the Hadzabe foragers. While traversing the Eyasi landscape, Hadzabe foragers constantly inventory its resources, including rock shelters, for future use. This indicates planning in land-use. The findings about the use of rock shelters by both MSA and LSA foragers in the Eyasi Basin are also relevant to the general phenomena of planning. The answers to the question about whether MSA foragers habitually anticipated and coped with their future needs as did LSA's remain controversial (Clark and Lindly 1989; Mellars 1988; Trinkaus 1989). Yet, the occurrences of deeply stratified MSA and LSA materials at one or two shelters suggest re-use or re-occupation of these shelters by both MSA and LSA groups. This suggests that MSA

and LSA forager mental processes and constructs were not significantly different with regard to the use of rock shelters.

Forager Land-use and Lithic Raw Materials

Aspects of raw material procurement and use can provide information about forager land-use system in the Eyasi Basin. Occurrences of "exotic" materials in the lithic assemblages can reflect ranges of contact with raw material sources either through visitation or exchange. Since lithic procurement is generally embedded within the subsistence system (Binford 1977), "exotic" raw material proportions in assemblages indicate territory size and degree of land-use. For example, highly mobile foragers will procure a proportion of "exotic" materials while less mobile foragers will procure mostly locally available materials.

On the basis of the occurrence of a small sample of obsidian, I broadly argued in Chapter 9 that "exotic" raw materials were probably not "seriously sought" for tool manufacture by both MSA and LSA foragers. In this section, I explore further the differences in raw material procurement and use between the MSA and LSA foragers of the Eyasi Basin. Instead of using the entire sample as I did in Chapter 9, I shall focus my discussion here on the excavated assemblage of Gordfani 2.

As described in Chapter 8, the lithic assemblage of Gordfani 2 is composed of MSA, MSA/LSA, LSA, and PN cultural

stages. As shown in Table 8-2, MSA material occurs in Levels X-XIV, MSA/LSA in Levels VII-IX, and LSA in Levels IV-VI. Clearly, from Table 10-1, there is an increase in the use of obsidian during the LSA. Yet, when examined carefully, the frequency of obsidian in the Eyasi Basin during the LSA is insignificant when compared to the large proportion of local materials. Since the Kenyan Central Rift obsidians could have been obtained through exchange or through residential movements of people (Mehlman 1989), its source distance may provide evidence of accessibility rather than land-use of an expanded territory. The occurrence of obsidian both in the MSA and LSA assemblages at Gordfani 2 and Mumba rock shelter indicate that obsidian was accessible to both MSA and LSA foragers of the Eyasi Basin. From the lithic data at least, differences in the frequencies of obsidian between MSA and LSA assemblages cannot be seen to reflect different procurement strategies. The bulk of raw material for tool manufacture during the MSA and LSA in the Eyasi Basin is not from outside the Basin. Even among the local raw materials, coarse grained cloudy quartz dominates both MSA and LSA assemblages (Table 10-1). One is left to wonder why there was no increase in the utilization of fine grained materials such as chert in the LSA when microlithic technology may have required high-quality raw materials? At Olduvai Gorge, the LSA assemblage ("Naisiusiu" Industry), for example, is dominated by high-quality Bed II cherts (Leakey et al. 1972) and at Lukenya by chert and obsidian (Barut 1994). The Eyasi

data reveal a different trend. One must ask how those differences are to be explained.

The lack of pronounced contrasts between raw materials and uses in the MSA and LSA could be interpreted as an indication that LSA foragers were not more mobile than MSA foragers. The Eyasi assemblages reveal patterns of localized lithic raw material procurement and use for both MSA and LSA. Since lithic raw material procurement and use are part of the subsistence and cultural systems, the prevalence of local raw materials in the Eyasi assemblages indicates that both MSA and LSA foragers had a dominantly local pattern of raw material procurement and use. This localized pattern of lithic raw material procurement and use does not appear to have significantly changed with the MSA/LSA transition. The majority of raw material for tool manufacture continued to be locally available materials throughout hominid occupation of the Eyasi Basin. I interpret this evidence as indicative of a self-contained localized pattern of behavior, adaptation, and residential mobility in the Eyasi Basin throughout prehistoric times. Hominid uses of the Eyasi Basin appear to be similar through time, despite evidence of "archaeological culture" change (e.g., new types of stone tools). Whatever changes may have occurred over time in the general pattern of hominid land-use in the Eyasi Basin, those changes seem to have included essentially constant access to the abundant low quality stones.

If the procurement and uses of locally available resources can be evaluated in terms of "economic" behavior, then MSA and LSA foragers in the Eyasi Basin were both capable of maintaining themselves without great cost. In fact, the argument that prehistoric foragers of the Eyasi Basin had a local pattern of land-use is supported by the analogous of Hadzabe foragers. As shown in Chapter 5, the historical subsistence activities and land-use patterns of Hadzabe foragers has largely taken place in the Eyasi Basin. In this time framework, they rarely go outside the Eyasi Basin and, when they do go, their activities outside the Basin are not related to subsistence or the procurement of raw materials. To Hadzabe foragers, the Eyasi Basin is their only "eco-space" where socio-cultural and economic activities historically and habitually occurred.

Table 10-1: Gordfani 2 Artifacts: Raw Material by Level.

	Levels					
Raw material	LSA	%	MSA/LSA	%	MSA	%
Obsidian	18	4.74	3	2.23	1	0.60
Chert	16	4.21	11	8.21	12	7.10
Basalt	1	0.03	3	2.23	8	4.71
Quartzite	6	1.60	12	9.00	6	3.53
Cloudy quartz	218	57.37	80	59.70	107	62.94
Clear quartz	121	31.84	25	18.66	36	21.17
TOTAL	380	100.00	134	100.00	170	100.00

Organization of Lithic Technology

In Chapter 9, I used the surface and subsurface artifacts to broadly highlight the organization of lithic technology across the cultural stages. In this section, I discuss the technological history of the Eyasi Basin by

focusing only on the excavated assemblages. My major interest here is to discover technological trends across the cultural stages in Eyasi Basin. The lithic assemblages used in this discussion include MSA, LSA, and PN materials (see Chapter 8, Tables 8-1 through 8-7).

Although the sample of shaped tools is small, there is no doubt that there are both changes and continuities in tool sizes and types across the cultural stages. Mehlman (1989), using a larger sample than mine, has clearly documented this trend in his study. It is clear from Mehlman's and my sample of shaped tools that while other tool types such as points disappear or were rarely or crudely made during the LSA and latter cultural stages, other tool types such as scrapers persist in the Eyasi Basin. In my excavated assemblages, scrapers occur throughout the shelter's archaeological sequences (also Mehlman 1989). This suggests some elements of "continuity" in scraper production and the continual presence of the need for scrapers across the different cultural stages in the Eyasi Basin.

An element of continuity between the different cultural stages of the Eyasi Basin is also suggested by the core reduction strategies. In Chapter 9, I identified four core reduction strategies for the analyzed assemblage: platform; peripheral; bipolar; and amorphous core reduction strategy. For the purpose of this discussion, only peripheral and bipolar core reduction strategies will be used.

The peripheral core reduction strategy occurs in many MSA assemblages in Africa; the Levallois, disc, and radial cores are the "type fossils" for the African MSA assemblages. When my excavated samples are examined, and that of Mehlman (1989), one sees that, with the exception of the Levallois core, the other core types of the MSA occur throughout the cultural stages in the Eyasi Basin.

The bipolar core reduction strategy, on the other hand, occurs in many African LSA assemblages. The bipolar core is a "type fossil" for African LSA assemblages. Although bipolar technology is characteristic of LSA, in the Eyasi Basin it also occurs in the MSA as well as PN (see Mehlman 1989; Chapter 8, Table 9-2). Although the importance of bipolar technology in the Eyasi Basin was recognized early on, bipolar cores are scarce during the MSA. When one examines changes in core reduction strategies, the Eyasi core sample suggests some elements of "change" and "continuity". In fact, the changes may be of degree, in particular in the increase of bipolar technology in the LSA. Although pyramidal cores, which were favored for the production of blades, occur largely in the LSA, they are scarce in the Eyasi Basin. This is also indicated by the dominance of flake blanks in the Eyasi LSA assemblages. As shown in Chapter 9, the majority of LSA shaped tools were made on flake blanks like that of MSA. Perhaps, the continuity in some aspects of lithic technology between MSA and LSA foragers in the Eyasi Basin reflects the use of locally

available lithic materials. Alternatively, it reflects similar technological skills between MSA and LSA knappers using the local lithic materials.

The analysis of the Eyasi lithic assemblages (Chapter 9), points to two systems of technological organization. As shown in Chapter 9, most of the primary blanks (flakes and blades), shaped tools, and cores conform to a systematic manner of production. Cores were selected from the procured lithic raw material. The selected cores were then systematically flaked using either a peripheral, platform, or bipolar reduction strategy. Some of the resulting blanks were then selected for further edge modifications. These were either retouched or backed to form shaped tools. As shown in the tables in Chapter 9, this systematic manner of core flaking and tool production transcend all the cultural stages.

This manner of tool production involved more planning and there is some evidence to show that even the produced tools were preconceived types. This is indicated by the sizes of shaped tools versus unshaped primary blanks. As shown in Chapter 9, retouched blanks are significantly larger than un-retouched blanks suggesting that larger blanks were selected for tool shaping. If, as argued by Barton (1990) and Dibble (1995), shaped tools were not preconceived types, but rather simply resulted from progressive edge use and re-sharpening, a variable size distribution should reflect this fact. During the analysis, I expected to find un-retouched

blanks to be larger than the re-sharpened and discarded tools. On the contrary, in the Eyasi Basin the retouched tools were larger than the un-retouched blanks.

Since some of the surface artifacts in the isolated scatters were shaped tools that were not in direct association with flaking debris and cores, it is possible that these tools were manufactured elsewhere and transported to the areas. Nonetheless, since we also found cores in some of the isolated surface scatters, the question of toolkit transportation in the Eyasi Basin needs further investigation.

The second system of lithic technology in the Eyasi Basin is the amorphous or casual technology. This is exemplified by the amorphous cores and retouched chunks and split cobbles. In this lithic technological system, shaped tools were perhaps manufactured according to needs at the place of activity. The cores are not standardized and they defy any typological classification. Casually shaped tools, in particular heavy-duty tools, occur in all the cultural stages in the Eyasi Basin.

Conclusions

This study began as an investigation of MSA and LSA forager land-use and lithic technology in the Eyasi Basin. The major focus was to examine the existence and magnitude of change in hominid behavior during the Late Quaternary period in East Africa. The major question addressed was what

evidence indicated "change" or "continuity" in hominid behavior between the MSA and LSA in the Eyasi Basin as reflected in land-use patterns and lithic technology.

The research involved surface archaeological survey, limited ecological survey, geomorphological survey, limited test excavations, and some ethnographic study of Hadzabe forager land-use and resource utilization in the Eyasi Basin. The focus of the surface archaeological survey was to study and record both low and high density artifact scatters and to use the information about the distribution of artifacts to infer hominid land-use systems. Overall, the research had a basin-wide focus. Unfortunately, due to time and financial constraints, as well as field logistics, only 20 km^2, or 0.8%, of the Eyasi Basin could be studied. Opinion differs as to how large the survey area should have been; nonetheless, the value of regional surveys is not in question. This is especially true in East Africa where regional studies are still in the embryonic stages. In fact, this study is the first of its kind in East Africa for the MSA and LSA periods.

The goals of this research, as outlined in Chapter 1 and further explicated throughout the dissertation, were to 1) provide preliminary data on the range of MSA and LSA archaeological occurrences; 2) investigate how MSA and LSA foragers organized and used the landscape; 3) recover hominid fossil material that would increase the size and quality of the African hominid fossil sample for the Middle and Late Pleistocene; and 4) determine, by means of surface survey and

limited test excavations, the archaeological potential of the region for long-term, multi-disciplinary studies (including large scale-excavations) of hominid biocultural evolution during the Late Quaternary. A secondary objective was to examine and investigate influences on present-day Hadzabe forager land-use and resource utilization in the Eyasi Basin with an eye toward uncovering patterns of Hadzabe forager land-use and resource utilization that could be used to develop analogical frameworks for explaining patterns observable in the archaeological record.

The first objective required detailed in-field typological analysis that simply was not possible due to time and financial constraints. Moreover, since Mehlman (1989) has established a relatively securely dated sequence for the MSA and LSA in the Eyasi Basin, I decided to focus my analysis of the assemblages on lithic technology and raw material procurement and use. The technological and raw material analysis was more pertinent to this study than the establishment or reaffirmation of a culture-history.

The results of the technological and raw material analysis were presented in Chapter 9; the implications of the analysis results were explored in this chapter. My inference has been that important aspects of the organization of lithic technology and lithic raw material procurement and use do not appear to have significantly changed between the MSA and LSA foragers in the Eyasi Basin. This has been further interpreted as indicative of continuity in hominid behavior

between the MSA and LSA, at least in core reduction strategies, production of some toolkits, and lithic raw material use. In addition, the pattern of localized lithic raw material procurement and uses for both MSA and LSA has been interpreted to indicate a shared basin-scale pattern of hominid land-use and adaptations. In other words, the LSA foragers of the Eyasi Basin are thought to have been not different in mobility from their MSA ancestors. In Europe and other regions of the Old World, it has been shown that UP (LSA) foragers were more mobile or had wider ranging patterns of lithic raw material procurement (e.g., via trade and exchange) than the MP (MSA) (Bosinski 1988; Kozlowski 1986, 1991; Montet-White 1991). Accordingly, I expected to see an increase in "exotic" and high quality (e.g., chert from Olduvai Gorge Bed II or Natron Basin) in LSA then MSA assemblages in the Eyasi Basin. This however, was not the case, suggesting that if LSA foragers were more mobile than MSA, and that if LSA foragers frequently ranged outside the Eyasi Basin as part of their adaptation, then those mobility patterns were not attuned to or driven by the subsistence and lithic raw material procurement systems.

One of the key discoveries of this research has been that MSA and LSA foragers of the Eyasi Basin may have had practiced similar land-use with regard to basic ecological afforadances. The surface survey has found MSA and LSA artifacts both occurring together in twelve of the fourteen surveyed areas. Also, the test excavations show that where

the archaeological deposits are long, both MSA and LSA artifacts occur with the latter stratified above the former (e.g., Gordfani 2). The isolated and low density distributions of artifacts indicate a "continuous" spatial use of the Eyasi landscape by both MSA and LSA foragers, while the high density scatters indicate "residential bases". This aspect of land-use does not appear to change between the MSA and LSA periods. The inference that I make is that both MSA and LSA foragers of the Eyasi Basin behaved or adapted similarly in their use of the Eyasi Basin.

Ethnographic analogy of mobile foragers (Chapter 5) and archaeological research shows that mobile forager land-use patterns are related to the subsistence and raw material procurement systems (Binford 1977). Accordingly, it is inferred that MSA and LSA foragers of the Eyasi Basin had similar cognitive abilities and adaptive behaviors in their utilization of the Eyasi Basin and its resources. In terms of land-use and lithic raw material procurement and use, the hypothetical boundary that some speculate separates "pre-modern" MSA foragers from "modern" LSA foragers is not in evidence in the Eyasi Basin.

Regarding the third objective of this research, a hominid specimen, designated Eyasi IV, was recovered from the surface along the lake shore (see Chapter 7). This specimen has been analyzed and described by Bräeur and Mabulla (forthcoming); here I will only summarize its important features. Eyasi IV consists of a fragment of the occipital

bone, measuring about 6 x 4 cm. Eyasi IV is identified as an upper central-right part of the occipital plane. Preserved anatomical features include a section of the lamboidal suture, the occipital sagittal sulcus, and small parts of the cerebral fossae. Eyasi VI was compared to Eyasi I and II originals and other "archaic" *Homo sapiens* specimens from Africa. Its morphology most likely points to an assignment to "archaic" *Homo sapiens*, similar to or somewhat more derived than Eyasi I. The discovery of this hominid fossil is important not only because it has added to the sample size for the Middle and Late Pleistocene of East Africa, but also because it permits morphological comparisons with previously found hominid fossils in the Eyasi Basin. The morphological comparisons of Eyasi I, II, and IV suggest some similarity, as well as variability, between them.

As shown in this dissertation, the Eyasi Basin has great potential for long-term, multi-disciplinary studies (including large scale-excavations) of hominid biocultural evolution during the Late Quaternary. The Basin is unique, not only because it offers the best opportunity to investigate hominid biocultural evolution and the interplay between hominid behaviors and their landscape in a Rift Valley System, but also because it offers the best opportunity to evaluate prehistoric foraging systems in light of a current, on-going foraging system, and vice versa.

In Chapters 4 and 7, I have shown the potential of the Basin for palaeoclimatic and geochronological studies. With

specialists, it is now possible to chronometrically date the Eyasi Beds' "Njarasan" Industry and the associated hominid fossils using the $^{40}Ar/^{39}Ar$ dating technique. In terms of the archaeological sequence, the Basin ranges from the "Njarasan", MSA, LSA, PN, IA, to Hadzabe items of material culture. This needs further investigation.

Of equal importance, the rock art of the Eyasi Basin discovered during this research, needs to be systematically studied, inventoried, and preserved. In fact, the study of the rock art of the Eyasi Basin has not yet come of age. Unlike the rock art of central Tanzania which has attracted the attention of many researchers and have been studied since the 1920s and; therefore, are relatively well known, those of the Eyasi Basin are less well known. Although rock art was first recorded and documented at Mumba rock shelter by the Kohl-Larsens in the 1930s several of the sites they discovered have not been visited again or even located on a detailed map. Therefore, the rock art of the Eyasi Basin remains to be discovered, recorded, and documented.

The Eyasi Basin is also unique in terms of hominid and faunal remains. Remains of "archaic" *Homo sapiens*, early AMH, and late Pleistocene or early Holocene humans occur. These human remains offer a rare opportunity to study not only their biological evolution, but also their cultural practices. For example, four of the eight test excavated shelters yielded Holocene human skeletal remains, some of which were in primary internment while others were possibly

in secondary internment. Similar discoveries have been made by Mehlman at Mumba rock shelter and Ikeda at Gisimangheda rock shelter. The demographic and osteological conditions, biological affinities, and cultural practices (e.g., burial practices) of these skeletal specimens is little known (Bräuer 1976, 1980; Ikeda 1982). Also, as shown in Chapter 7, we discovered burial cairns during our survey. The cultural affinity of these cairns is not yet known and the change in burial "sites" (e.g., from rock shelter to open air) needs to be investigated.

The occurrences of IA and ancient irrigation systems call for further long-term investigations. The study of ancient irrigation systems can be compared with the present systems, as the majority of the Eyasi Basin inhabitants continue to practice a traditional irrigation that is based on gravitation (see Chapter 4).

The study of Hadzabe forager land-use and resource utilization has revealed and raised important archaeological issues. In particular, the seasonal but continuous spatial use of the Eyasi Basin has direct behavioral implications for the interpretation of the archaeological record of the Eyasi Basin. As shown in Chapter 5, the Hadzabe seasonal land-use of the Eyasi Basin is attuned to the seasonal distributions of resources. Nonetheless, as discussed earlier, ecology is not the only influence on the Hadzabe land-use system. Cultural, as well as economic factors not related to subsistence, play important roles in structuring Hadzabe

mobility in the Basin. Using the Hadzabe forager analogy, I hypothesized seasonal land-use and resource utilization systems for the MSA and LSA foragers. This hypothesis could not be tested given the available data.

The Hadzabe use of rock shelters is one of the key discoveries of this research. As the test excavations have shown, rock shelters demonstrate their potential for habitation in the Eyasi Basin from MSA times to the present. The use of rock shelters by Hadzabe foragers, therefore, has important implications for the understanding of prehistoric use of rock shelters in the Eyasi Basin. For example, the discard of debris by Hadzabe in rock shelters shows that excavation units placed in the center of shelter floors will not always recover archaeological materials that are representative of all the activity that took place at the shelter. Also, the study of Hadzabe use of space in shelters can provide not only a basis for understanding the use of space by prehistoric foragers, but also a basis for inferring prehistoric demography. Although the Hadzabe research has revealed many archaeological implications that could not be tested during this research, clearly their regional land-use and resource utilization will contribute in the future to the interpretation of the Eyasi Basin's archaeological record.

In summary, this study has not solved all the mysteries of MSA and LSA forager land-use and adaptation as originally hoped, but it has underscored the similarity in behavior in a given landscape between the MSA and LSA foragers. In any

case, I do not claim that there are no behavioral differences between MSA and LSA in other aspects of culture; rather, I argue that the differences were due to different factors (e.g., diet choice, environment) rather than the neurological or behavioral inferiority of MSA foragers. The conclusion reached in this dissertation about MSA and LSA forager land-use and adaptation in the Eyasi is important because it shows how complex and varied the adaptive and cultural systems of MSA and LSA foragers were, and how dangerous it is to generalize about such complex issues.

Limitations of the Present Evidence

Surface and sub-surface occurrences of MSA and LSA materials in the surveyed and test excavated areas indicate that MSA and LSA foragers may have had similar land-use patterns and adaptive strategies in the Eyasi Basin. This inference is, however, limited as additional information needed to further test it is insufficient at present.

First, while forager land-use and adaptation may be read from the distribution of surface artifacts across the landscape, the causes of such distribution are many and not always cultural. Although I have argued that the erosion and depositional processes would not have destroyed or significantly disturbed the occurrences of the surface artifacts in the surveyed areas, other non-cultural formation processes may have caused the patterning of the MSA and LSA artifacts that I observed. Difficulties in identifying all

the formation processes responsible for the surface artifact patterning is, however, not necessarily the failure of the archaeologist, but rather a problem with all surface surveys.

Second, due to time and funding constraints, a larger coverage of the Eyasi Basin was practically impossible. At present, it is not clear how large areas should be surveyed to provide meaningful conclusions. Nonetheless, it is possible that a survey of larger, more ecologically and geomorphologically diverse areas may reveal different MSA and LSA forager land-use patterns and adaptations in the Eyasi Basin.

Third, it is not clear, at present, just what aspects of artifact distribution one can measure and contrast that have to do with varying mobility and the sequential use (and re-use) of places and things. If this is a problem, then it is a problem with all spatial and/or regional archaeological approaches. Archaeologists have not, in general, come to grips with this issue.

Fourth, reliable palaeoenvironmental evidence for the Eyasi Basin is lacking. New palaeoenvironmental data may lead to different hypotheses, predictions, models, and interpretations about MSA and LSA forager land-use and adaptations in the Eyasi Basin.

Fifth, although the Hadzabe I studied can still be defined as foragers, they are not "pristine" or directly representative of the prehistoric ones. My use of Hadzabe analogy was aimed at modeling and testing possibilities for

Late Quaternary forager subsistence, mobility, technology, social organization, and demography in the Eyasi Basin. This concurs with "middle range" approaches in being based on the Hadzabe regional analogies, and in seeking to test them by using the regional archaeological record.

Finally, while the occurrence of either local or "exotic" lithic raw materials in archaeological assemblages may offer clues to the degree of forager ranging patterns, the obtainment of lithic raw materials may not have been the only influence of MSA and LSA forager mobility outside the Eyasi Basin. It is possible that MSA and LSA foragers of the Eyasi Basin had wider social or subsistence ranging patterns than that suggested by the dominating local lithic raw materials.

In spite of its limitation, this study demonstrates that closer scrutiny of forager land-use patterns and adaptive strategies at the regional level, by survey and limited test excavations, can completely alter our understanding of the past. The significance of this study goes beyond the conclusions reached about MSA and LSA behaviors and adaptations in the Eyasi Basin. The study illustrates the total usage of the Eyasi Basin by prehistoric and modern foragers and the need for East African archaeologists to come to terms with regional perspectives if we are ever to comprehend the complexity of prehistoric forager lifeways. Also, the study indicates how important an artifact surface survey is if we want to create effective Cultural Resource

Management (CRM) programs in Tanzania. Surface survey adds a whole new dimension and is vital in any research area if we are to reach a more meaningful reconstruction of how people lived in the past.

Future Directions

The ecological and spatial regional approach used in this study, combining surface archaeological, geomorphological, ecological, and ethnographic survey, as well as test excavation, has been exploratory in nature. As discussed in Chapter 6, critical methodological and logistic problems were encountered; this is not uncommon in archaeology.

In future research, I will give more attention to sampling procedures, data recovery techniques and spatial recording, as well as in-field typological and technological analysis. The use of GIS in particular, will facilitate artifact recovery, recording, and mapping of the surface scatters. Moreover, I will devote more effort to resolving the chronology of the Eyasi "archaic" fossil hominids and their associated "Njarasan" artifacts. There is a great need to refine our current knowledge of climatic changes in the Eyasi Basin and their environmental consequences. The study of past environments of the Eyasi Basin is therefore, crucial for the understanding of the interplay between culture and the environment. A proper documentation, inventory, and distributional study of "wild" plant food in the Eyasi Basin

is needed and is already overdue. All these issues constitute a long-term multi-disciplinary project.

Furthermore, the research shows it is possible to plan and conduct short-term research projects with relatively small teams and budgets. These short-term projects will include further excavation of rock shelters that have revealed relatively deep archaeological deposits with the goals of clarifying the contexts of the human skeletal remains and recovering new uncontaminated dateable materials. Further, the study of rock art, in particular survey, documentation, and inventory, can be integrated into both short-term and long-term projects. Of utmost urgency, however, is a systematic study of Hadzabe land-use, including their usage of rock shelters, in the Eyasi Basin. The traditional life ways of Hadzabe foragers are rapidly disappearing in the face of modernization. As shown in this dissertation, research on the Hadzabe usage of the Eyasi Basin has the potential for generating not only analogs for interpreting forager's archaeological patterns, but also for developing explicit arguments for the linkage of ethnoarchaeology to the theoretical or epistemological framework of archaeology.

APPENDIX
ATTRIBUTE DEFINITIONS, OBSERVATIONS, AND MEASUREMENTS

The selection of variables and attributes appropriate for any artifact analysis is both highly important and difficult. Being aware of this, and the crucial role morphological and technological variables play in lithic analysis, a great deal of thought and research went into compiling the attribute list. The lithic attribute analytical scheme I used is primarily a combination derived from several sources, primarily Bamforth (1989), Bison (1990), Brandt (n.d.), Clark (1974), and Mehlman (1989). Nevertheless, in every stage of analysis, modifications have been incorporated as deemed necessary. A variety of technological and morphological lithic attributes was observed, measured, and recorded. The recorded attributes for the Eyasi Basin assemblages were both qualitative and quantitative.

Quantitative Attributes

Flakes and blades. Maximum measurements were made of length, breadth, thickness, weight, platform inclination angle, platform remnant size, and quantity (in percentage) of

natural surface (cortex). In addition, the number of dorsal scars or ridges were counted.

Cores and non-flaked stones. The standard metric of length, breadth, thickness, and weight was measured. The angles of inclination of major platforms were measured for the cores. In addition, the number of scars left on the core and the number of striking platforms present were counted. Also, the quantity of natural surface was measured.

Shaped tools. The standard metric of length, breadth, thickness, and weight was measured. The angles of retouch or backing and the invasiveness or extent of retouch or backing were measured. In addition, the number of dorsal scars or ridges were counted. For backed tools, the thickness of backed edges was measured. On burins, the number of burin facets was counted and the angle of burination and the width of the burin cutting edges were measured. The quantity of natural surface was measured for all shaped tools.

Qualitative Attributes

Flakes, blades, proximal fragments, and angular fragments. The attributes recorded include: type of striking platform, bulbar definition, physical condition, patination, plan form, blank type, cross-section, and dorsal scar patterns. The type of flake termination was recorded for flakes and blades that exhibited a platform remnant.

Shaped tools. The recorded qualitative attributes include those mentioned above for flakes and blades, as well

as type of tool, retouch or backing class, working edge shape, retouch or backing type, locations of retouch or backing, formation and placement of notch, bit (point) shape, and butt shape.

Cores. I recorded the type of cores, traces of platform preparation, major platform shapes, number of platforms, stages of core abandonment or discard, technique of core flaking, and types of termination of flake scars. Also recorded was the core's most likely initial material shape.

Artifact Classes

The lithic assemblages were first sorted into the following six major categories:

Shaped tools. These are complete stone artifacts with systematic secondary modifications (retouch or backing) covering at least half of the edge.

Utilized artifacts. Any chipped artifact with either marginal secondary modification or edge damage that does not cover at least half of the modified or damaged edge.

Flakes and blades. These are pieces of flaked stone with intact margins, distal ends, and at least a platform. Although other features such as a bulb of percussion and ripple marks on the ventral surfaces are of particular importance in defining flakes and blades, in many cases these features were not exhibited by the quartz flakes and blades.

Cores. These are stone cobbles, pebbles, or nodules from which flakes have been removed. Cores exhibit negative

bulbs of percussion, negative scars, and have striking platforms or flat surfaces from which flakes were struck.

Non-flaked stones. These show no negative flake scars and may have 100% cortex. These were used either as hammerstones, grinding stones, or anvils. Accordingly, the edges may be polished, bruised, pecked, etc.

Angular fragments. These are pieces lacking either flake talons, edge modifications, or platform edges.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

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